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Material Handling Equipment

February 1, 1925

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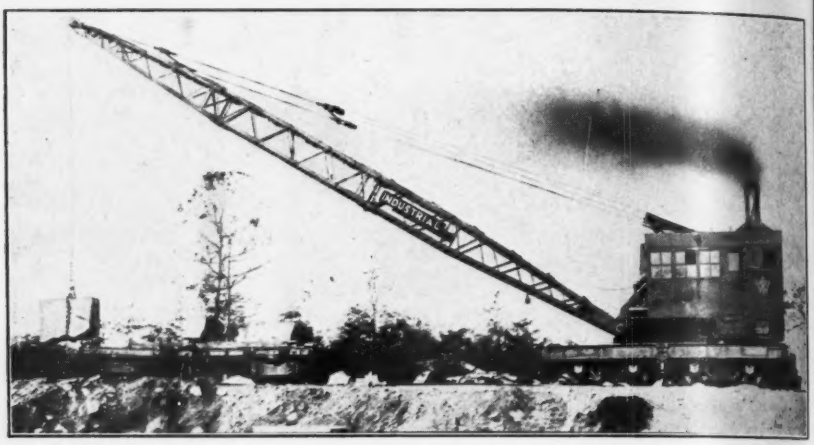

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Pit and Quarry

A Semi-Monthly Publication for Producers and Manufacturers of Sand, Gravel, Stone, Cement, Gypsum, Lime and Other Non-Metallic Minerals.

VOL. 9 CHICAGO, ILL., FEBRUARY 1, 1925 No. 9

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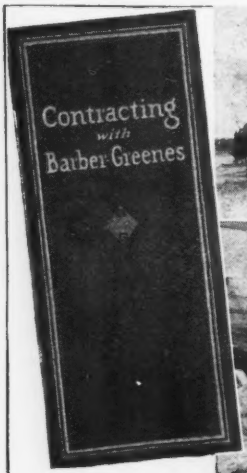
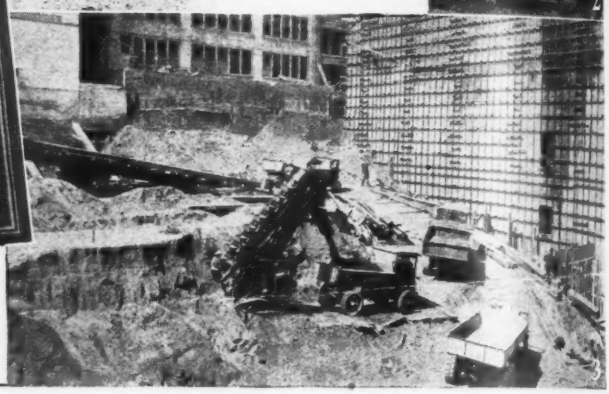


This book, showing a number of the new uses to which Barber-Greenes are being put, will be sent upon request.

1—Batching and loading gravel on a concrete road job.

2 — Handling loosened subgrade material.

3—Loading on a building excavating job.



Doing 20 Different Jobs for Contractors

The rugged efficiency of Barber-Greenes is illustrated by the many exceptional and tough jobs to which they are put—in addition to their regular job of handling and batching aggregates for road work.

On a large building excavating job, in San Francisco, a model 42 Barber-Greene Bucket Loader stepped right into the shoes of a steam shovel. The job was no snap. The ground was composed of wet, stiff sand that had to be broken off its bank with bars and allowed to cave in on the nose of the Barber-Greene. The business end of the machine was almost completely buried at times.

In spite of those difficulties the Barber-Greene was able to dig and load fast enough to fill a five-ton truck in two and one half minutes and a two-ton truck in one.

This model Barber-Greene has practically become the standard for material loading on road jobs. "We would not go back to the grief of hand labor even if it could show the same low cost," is a common expression among Barber-Greene owners.

An increasing number of contractors are pushing their Barber-Greenes into more difficult lines of work, similar to the jobs described above. Loading scarified macadam and cutting grade are now becoming ordinary tasks for Barber-Greenes. Pretty stiff jobs, these, but the patented Barber-Greene disc feed walks through them and leaves a spick-and-span grade behind it. In the new Barber-Greene booklet, *Contracting with Barber-Greenes*, twenty different uses to which Barber-Greenes are being put, are shown. In addition, there are the more conspicuous of last year's developments in material handling layouts.

As this booklet will prove of unusual interest and value, it will be sent to all those requesting it.

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Pit and Quarry

Vol. 9 Chicago, Ill., February 1, 1925 No. 9

Being an Executive

INVENTORIES occupy the attention of executives in most industries during the early months of the year. It is the time to check up and to find out just where one stands. The importance of "taking stock" cannot be overestimated. There is another kind of inventory, however, that is frequently ignored,—the analysis of one's executive ability. The successful executive will be as much concerned with his own improvement and growth as he is with the status of his business. He will plan as systematically for increase of efficiency in himself as he will for greater financial returns in his business.

Increased executive ability means growth, and growth leads to cultivation. Random growth is a waste of material. The scientific farmer operates on this theory and gets from the soil maximum returns. There is no increase in executive ability for the man who sits inert and watches the year roll past. He would look with scorn upon unscientific methods in industry or old-fashioned farming. His organization, no doubt, uses the best and most up-to-date equipment. He points with pride to the great machines which serve him so profitably. Yet in the business of being an executive he is as out-of-date as a hand shovel, as unscientific as a wheelbarrow, as old fashoined as the industries of the days of his grandfather.

What is an up-to-date executive? How can he take inventory of his ability? He is first of all a leader. Leadership is a quality which is either natural or attained. Natural leadership must be cultivated and directed; attained leadership must be improved and stimulated. In either case leadership is unavailing unless it reaches out to the minor executives and through them to the employees. There is no use for leadership unless one leads. In any organization men desire to be led; they are amenable to suggestion and prefer to respect authority. Their contribution to the success of the industry is greater if they are aware of real leadership at the head. They like to be proud of their chief. A real leader utilizes all of the energy and capacity of his subordinates. He wins the confidence of those he leads. He secures for his business every available benefit. If there is an individual anywhere in his organization who possesses unusual ability, he knows about it and provides an outlet for that ability to the advantage of all concerned.

A second quality of the alert executive is vision. He not only leads but he sees far ahead of any one else. His outlook is not bounded by the four walls of an office nor by the obstruction of a closed mind. He sees far beyond any one day or any one problem. Changes come fast, but he is meeting the future while others are contemplating the present. The executive with vision may be surprised, but he can never be baffled. He has looked forward to the possibilities of tomorrow and anticipated the vagaries of the future so entirely that he is never caught napping. He reads the signs of the times and profits by them. He lets no petty disturbance of the moment obscure for him the interesting and inspiring panorama that is spread before him. Such an executive must have the third quality for success, a desire for new ideas.

The intelligent executive welcomes new ideas as he welcomes the new day. He is never indifferent to that which leads to progress. Stagnation means death; movement, energy, vitality mean life, life for the organization. Anyone can operate a machine, hire workmen, boss a gang, or add a column of figures. But the future calls for better machines, for more skillful workmen, for intelligent management of groups, and for cost accounting. Some one must be working on these problems. Some one must be studying every phase of the industry, seeking new methods, try-

ing new experiments. Ideas are the biggest things in the world. The executive who recognizes the worth and practicability of an idea will inevitably forge ahead.

A fourth essential in the executive is an intelligent cooperation with industrial and scientific research. Scientific research has long been recognized; industrial research is now coming into its own. The first concern of industrial research was with the product, the material thing to be made. Here it has been aided by development in chemistry, physics and the applied sciences which are now its greatest aid. The next problem was the process, the machinery and the methods of production. In this field we are making enormous advancement. Not only are we improving machinery and equipment but we are changing our methods, eliminating waste and increasing production. Industrial research includes a study of the personnel of an organization. It takes account of individual attributes, of the psychology of the employee, of conditions which make certain a maximum output with a minimum strain. Such intensely interesting problems belong to the executive. He may apply to himself some of the searching questions of the scientist. He may appraise his own capacity for filling his position just as he would test a piece of equipment. This leads to the second question. How can an executive take inventory of himself?

An inventory tells the plain truth; it shows us where we stand. The purpose of the yearly inventory is to ascertain how the net profits of the year compare with those of the preceding year. The questions that the executive might face in his personal inventory concern different values, but real values. How have I aided my subordinates in their efforts to increase their worth in the organization? What have I done to raise the standards of my subordinates, to inspire them with ambition to improve? How much greater is the confidence which my subordinates have in me? Do they respect me more than they did last year? Do they feel deference for my opinion? Do they consider me an authority in my field? Are they proud of "the old man?" Do they feel free to come to me for advice, for consultation? Do they have a sense of pride in the organization? Are they loyal? Have I secured a sound basis of friendliness? How do I rate with other executives? What have I done to further the interests of the industry in general? What have I contributed to the increase of prosperity in this industry, to its future development?

These are direct, searching questions, questions that can come only with a frank, honest introspection. No one could make such inquiries of another; no one could answer them except himself. Only the man who is concerned with his personal growth and who is fearless will take inventory of his executive ability, but such men are highly valued in the industrial world.

Profits from Better Equipment

THAT concern which replaces its equipment as soon as better equipment is available and which is constantly alert in watching for opportunities to substitute mechanical power for man-power is generally more profitable than the conservative one that delays the installation of better equipment until the old has completely worn out and that thinks men are cheaper than machines.

The value of the most modern cost cutting and labor saving equipment is quite generally realized by all progressive producers. Nearly all the profitable plants are directed by men who are open-minded in their willingness to investigate every device or tool that promises to do a job more rapidly or at less cost.

It does not pay to overlook small savings. Insignificant additions to equipment will make notable reductions in costs. There are some plants that could make large and spectacular savings. In general, however, the savings will be individually small but in the aggregate will loom up as a startling figure.

The advantage of low operating costs is reflected in the marketing of the product. There is no greater selling advantage than being able to meet the other fellow's price. If your production costs are lower than your competitor, you have a decided advantage. Within a few years it will be universally true that he who is slow to adopt modern methods will be doomed.

Workmen's Compensation Insurance and Accident Prevention

Written Expressly For PIT AND QUARRY By DWIGHT INGRAM*

THERE is no such thing as an industrial accident. A radical statement that is, and superficially untrue. For statistics as well as common sense affirm that scores of men are injured daily at their work. The U. S. Bureau of Mines estimates that in 1923 in stone quarries 1.68 men were killed and 176 injured out of every thousand workers. More serious is the fact that four quarry employees per thousand are totally disabled every year, because these injuries leave not only dependent women and children but also helpless men to be cared for by society.

Injuries and deaths in industry do happen regularly. To claim that these are not accidents is to point out that they are not "acts of God," like tornadoes and earthquakes, but are all within control. It is hard to conceive of an accident in industry that is not due to the carelessness or neglect of someone. Usually it is the injured man himself that is to blame, though it may be his boss who gives a wrong order, it may be the plant superintendent who fails to foresee that a certain operation will some day result in tragedy, or it may be the manufacturer of a machine that is defective or ill-adapted to its work. All these accidents are preventable and unnecessary.

The appalling wastage of human life and health leads at once to two lines of action: to work for accident prevention and to protect the employer's legal liability by insurance. A steady drive for accident prevention on the part of an employer will eliminate the physical pain and suffering of the injured and will bring the reward of uninterrupted operation. For the biggest cost of industrial accidents is not the insurance premium: it is the lost time taken by men who have to report to the doctor and the lost motion of training new men for the jobs of injured employees. The second factor, insurance, is important because it sets a guaranteed maximum cost to the industrial hazard and permits a producer to figure this item in his budget without the risk of expensive law suits.

There are two starting points for a program of accident prevention. First is your insurance agent or a safety engineer from his company's home office. This can produce the best system, for it can be intelligently fitted to your exact local conditions. Its success, though, is limited by the energy and resourcefulness of the insurance man you get. The second pan is to study the safety code published by your state authorities and see that your men, especially foremen, understand it. It is probable that you have already given careful thought to the obvious hazards of blasting and of hoisting apparatus, but you may be surprised to find that unsafe stairs and ladders, loose stone that may be stepped on, talking while on duty by hoistmen or signalmen, and other lesser details are just as liable to cause accidents. The Wisconsin safety code, for instance, is fairly thorough. If the producer will apply it rigidly and add to it any rules of his own that local conditions demand, the number and seriousness of accidents will be materially cut down.

The most important feature of prevention work is to fix the responsibility for every accident that occurs. Our natural tendency is to feel tender and lenient toward the poor man who is hurt, accept his story that he couldn't help it, and resume operations with a substitute borrowed from another job. Of course, we can never be brutally inhuman. Injuries are painful, and for the emergency the man is entitled to the best of medical attention and sympathy. But immediately after an accident the plant superintendent must make a personal investigation of the cause. He must see whether all nearby machinery was in good order, whether other workmen or bosses were doing their jobs right, and whether the injured man was following instruction in his own work. Then when one knows the cause, he must act decisively and fearlessly to see that the same thing is not repeated. If an employee cannot handle his work safely he should

*Engineer—Moore, Case, Lyman and Hubbard.

be switched to another department. If he is chronically careless in spite of warnings, the plant will be better off without him, for no man is worth the cost of the interruptions to operation caused by accidents. And if it is determined that the fault lies with a piece of machinery, that device must have a guard or otherwise be made safe.

Whether a plant is small or large it should have a safety organization. As a matter of experience a producer will probably forget about the safety code and the investigation of accidents during the rush season. His whole thought is focussed on the production of material, and when the plant is working under pressure is both the time when accidents are most likely to happen and the time when the owner can least afford to have operations slowed up by them. Accidents cannot be ignored if a safety organization is formed, because the routine functions go on mechanically whether the superintendent has his mind on them or not.

There is no cut and dried standard type of safety organization. Each business man invents his own, and the complexity of it depends on the size of the plant. The following features of a safety organization are fundamental. Every producer should have at least this much. For large plants it is only necessary to amplify these or create subcommittees in the several departments.

The Instructor—Every producer should find an old, reliable employee, preferably not a foreman, and designate him as instructor of new employees. This man should make a careful study of the accident hazard of every job in the plant—the unguarded moving parts of machines and the opportunities for carelessness. Then whenever a new man is hired or an old one is transferred to a different job, the instructor should spend a liberal amount of time with him individually until the man is thoroughly posted on the risks and chances of neglect or carelessness in his own particular work.

Inspectors—One employee (or two, if the plant is large enough) should be designated as safety inspector. His duty is to make a complete round of the entire property once a week, checking up to see that all the regular safety devices are in order (such as water barrels or fire extinguishers, guards on machines, elevator guards, doors railings, etc.) and note any condition that might cause an accident and that could be improved. The result of each inspection should be set down in writing. The inspector is also a sort of local policeman; if he notices any employee, even a superior, violating some safety regulation, he should quietly warn him that unless the offender changes his method he will be reported to the superintendent. Each inspector should serve for a term of from six to eight weeks. In this way every regular employee will eventually have a turn at the job. They will all learn about the safety devices, they will become accustomed to keeping their eyes open for improvements, and will above all appreciate the importance of being careful.

The Safety Committee—A safety supreme court should be established, composed of the superintendent, treasurer, and other executives or senior foremen. This committee will always meet once a month, with special meetings in between when necessary. It will read over the inspectors' reports and order any improvements which the inspectors, instructor or foreman may recommend. It will hear the report of investigation of every accident that occurs and of what the superintendent has done to prevent the same thing from happening again. And thus with no great loss of time the heads of the business will have a constant, comprehensive grasp of the safety problem in the plant.

Accident prevention pays in two ways. It reduces physical suffering. And it saves the producer money. Almost universally an employer is legally liable for injuries suffered by his men in line of duty. This liability is generally worked out in detail by state compensation laws, and the employers protect themselves by insurance policies. So the cost of insurance becomes the cost of industrial accidents to the producer. Taking the larger insurance companies, for example, the expenses of policy writing, bookkeeping, inspection work, etc., equal about 25 per cent of the total premiums paid for workmen's compensation insurance; abut 5 per cent is required for big catastrophes or explosions which are too expensive to be loaded on to a single industry; and about 65 per cent goes to pay the cost of accidents in the individual plant. These figures incidentally show that the stock insurance com-

panies are losing money on workmen's compensation right now. But the important deduction is that 65 per cent of the average premium is within the control of each producer, and there is hardly any limit to the rate reduction that can be secured through safety engineering and education of employees.

Compensation rates, like fire insurance rates, are made according to a scientific schedule which measures the probable seriousness and frequency of accidents in each plant. The schedule takes into account three factors. First is a manual giving the "basis rates" for every type of industry in each state of the Union. The basis rate represents the cost of accidents in average plants. The following extracts from the basic manual are typical:

Class	Rate per $100 of Pay Roll Ill.	Ind.	Wis.
Sand and gravel digging	3.46	4.01	6.50
Stone crushing (no quarrying)	2.97	3.25	4.58
Quarries—crushed stone	5.68	6.57	7.41

The difference in rates is due partly to differences in loss record of the states and partly to differences in the benefits provided by law for injured employees.

The second step in rating is to send an inspector to the individual plant. This man makes a record of the amount of machinery, number of unguarded moving parts of machines and other local accident hazards. On the basis of this report the "manual rate" is either increased or reduced to fit the individual conditions.

Finally the insured employer or his insurance company furnishes the state bureau with a detailed list of all accidents to his employees during the past one to five years. This record is compared to an "average" plant of the same size, and the rate is again increased or reduced appropriately. This final figure is the rate which the employer pays on each hundred dollars of pay roll.

Technical advice by a safety engineer will remove many potential hazards and educating employees to be careful will improve the last record. This is the way accident prevention reduces insurance rates.

The actual cost of workmen's compensation insurance depends not only on the rate but also on the audit of pay roll at the end of the policy year. Annually or oftener an auditor visits each insured plant to check up the books and adjust the original estimated premium according to the exact pay roll. Now it happens that a single plant has many kinds of employees, such as clerks, chauffeurs, hoistmen. Many of these classes have separate insurance rates of their own, either higher or lower than the principal rate, and their pay roll has to be segregated and separately charged. The inspecting auditor, of course, is ordinarily honest. But in some cases he may make mistakes, and always he remembers that he is paid by the insurance company. So in case of doubt or ignorance he can be counted on to allot the pay roll to the highest rated classifications. Skillful coaching by the insurance broker on how to classify the pay roll will sometimes save the producer as much money as a full program of accident prevention work.

Some of the most misunderstood classifications of pay roll are as follows:

Executive officers of a corporation (president, vice-president, secretary and treasurer) are insured. But their salaries are not charged for if their duties are limited to executive, sales or clerical work. If they are exposed to the regular industrial hazards by working even a part of the time as operating foreman or workman, their whole salary is charged for under the main classification. An individual employee or members of a copartnership are neither charged for nor covered by insurance. If protection for them is needed they must buy a regular personal accident policy.

Clerks and draughtsmen are insured very cheaply, at a rate of about five or six cents per hundred dollars of pay roll where the industrial rate may be $3 or $4. It is desirable to put as much of the pay roll as possible in the clerical group. The greatest confusion comes over the shipping clerk. In spite of his title of clerk, his job takes him into the working plant and he is a part of the main industrial risk.

Chauffeurs and their helpers, including all men whose work is in the garage or on automobiles, take a special rate, usually lower than the other employees.

Bonuses and commissions are a part of the pay roll if they are one of the

recognized features of the job. But they are not chargeable if they are given for "meritorious achievement" or for discovery of some improvement in operation, or pure gifts or as the result of voluntary profit sharing where they are not a part of the contract of employment. These definitions are subject to different interpretations, and careful wording of any bonus arrangement may keep it out of the chargeable insurance pay roll. Board, lodging and rent concessions are also a part of an employee's remuneration and must be accounted for in the audit.

Workmen's compensation or employers' liability insurance can be bought from several kinds of insurers. A scattered few states provide a public fund, administered by political appointees or a permanent state clerical staff, and either force or permit employers to buy insurance, the annual deficit, if any, being paid for by the tax payers. This plan is losing popularity, as is shown in New York State where the public fund has dwindled down to carrying less than eight per cent of the insurance in the state.

A second form is the reciprocal or inter-insurance exchange. This is not an insurance company. It is a group of individual employers who agree to share each other's losses by paying an initial deposit and any necessary balance by assessment. Reciprocals attempt to sell their indemnity cheap, because an anticipated low cost is their only real sales argument. Policy holders in a reciprocal are not only liable for assessments, but also under some conditions they can be called on to repay dividends of past years, even though those dividends were received in good faith and already spent.

Mutuals are insurance companies without capital stock. They do not pay dividends to stockholders, but conversely they do not have the backing of invested capital to meet heavy losses and they do not have a keen group of stockholders watching the officers to keep down expenses. A stock company is safer than a mutual by the amount of the capital stock. While mutuals are popularly supposed to sell their indemnity cheaper, the difference is more apparent than real. Both employ clerks, inspectors and doctors at the current market value for such men. The dividends paid to share holders in a stock company are made up for by their selfish demand for greater economy and efficiency in management. When a mutual quotes a lower rate than a stock company in competition for business it often means that the stock company agent has not made a careful analysis of his client's accident hazard. An intelligent study of how to improve conditions can reduce the stock company rate to a point where mutuals are afraid to take the business.

In summary the buyer of workmen's compensation insurance should reduce the number of accidents in his plant to the point where he can practically dictate his own rate. To do this he must find a broker or agent who either knows accident prevention himself or who can call on the services of a high class safety engineer. Such an agent will give advice and will stay "on the job" until his client is getting an insurance rate truly in proportion to the safety of his plant.

Cost Reprints Available

Upon request, a thirty two page pamphlet on "Cost Accounting in the Crushed Stone Industry" will be sent without charge to any crushed stone producer and to others interested, as long as the supply lasts. This pamphlet is a reprint of six articles on "Cost Accounting in the Crushed Stone Industry" by D. J. Hutchinson which appeared in the issues of PIT AND QUARRY from September through December 1st, 1924.

Requests should be addressed to the Editor of PIT AND QUARRY.

Crescent Portland Cement Co. Orders Westinghouse Equipment

The Westinghouse Electric and Manufacturing Company has recently received a contract from the Crescent Portland Cement Company for power plant equipment to be used to modernize the present plant at Crescentvale, Pa. Increased production has necessitated additional power facilities to take care of the increased load.

The equipment consists of two 3,000 kw., 2200 volt, 3 phase, 60 cycle turbine generator units equipped with surface condensers and auxiliaries. In addition, the contract calls for a switchboard substation and six 500 Kv-a. transformers.

Producing High Calcium Limestone Under Favorable Conditions

Railroaders' Lime Company Working Quarry at Corydon, Ind. The Hillside Plant Eliminates Considerable Material Handling

AMONG the hills of Southern Indiana lies the old town known as Corydon, which at one time served as the capital of the state. Corydon is located about seven miles from the main line of the Southern Railway from Louisville to St. Louis. A short independent line runs from Corydon up to the Southern road. Since the advent of the auto truck and passenger busses this railway has been in hard straits to make ends meet. A rock crushing plant was put in with the express purpose of giving the road tonnage enough to warrant continuing operation.

Corydon is located in the Mitchell division of the Mississippian limestone. Northwest of the town there is a limestone bluff 225 feet high at the foot of which is an unlimited water supply in the form of a creek which is fed by innumerable springs. The quarry of the Railroaders' Lime Company is located on this bluff. This quarry was opened twenty years ago but never operated extensively. Three years ago this company leased the property and started to develop it with the idea of building a lime burning plant. Experimental kilns were built and operated with very good results. Then work was suspended in order to concentrate on the development of the gas field located in this vicinity.

The quarry is at the top of the bluff and affords an excellent hillside operation. The face of the quarry is 75 feet leaving the quarry floor 150 feet above the lower level. The lower strata of the bluff are too soft as they are mostly shale and silicious limestone. The rock in the quarry face is very uniform and a high calcium limestone. Work was started on the new plant last summer and the plant was completed and put into operation October 1st. The accompanying illustrations give a good idea of the whole installation.

The rock is dumped into a chute leading to a number 6 McCully gyratory crusher. From the crusher it is fed on a 30 inch Marco conveyor belt 25 feet long into a Gruendler revolving screen. The rock then drops into chutes and slides to the front of the bin where it is loaded on cars or trucks. The upper section of the bin is used for storage purposes. No stone is elevated or handled after it is dumpd into the rock chute. A system for handling the rock in the quarry, such as track, side dump cars, and a small shovel is to be installed in the near future.

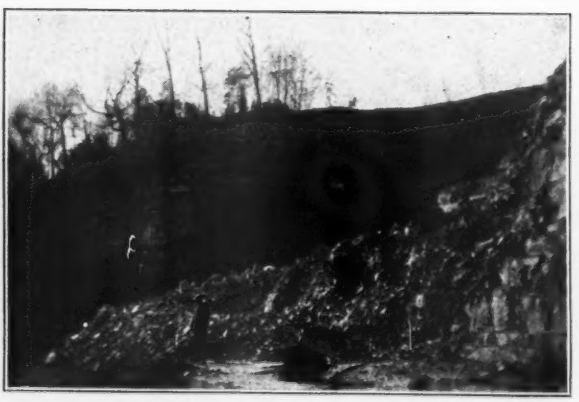
The entire plant is operated by electricity. The power is received at 2300 volts and stepped down to 220 volts. The crusher is operated by a 50 H. P. Pioneer slip ring motor made by the Louisville Electric Manufacturing Company, Louisville, Kentucky. The screen is run by a 15 H.P. General Electric induction motor as is the air compressor needed for this job. All block holding is done with a Wonder drill made by the Hardsocg Drill Company. The primary shots break up the rock so well that very little block holing is necessary.

View of Plant from Spur Track.

The large blast holes in the 75 foot ledge are

View Showing Face of Quarry.

View of Quarry and Plant.



View Showing Face As It Is Shot.

put down by a Wyman pipe drill which cuts a 4-inch hole. The holes are placed 12 feet apart and 20 feet from the toe of the face. The holes are drilled about three feet below the quarry floor and are loaded to 18 feet from the top with 60 per cent Dupont quarry gelatine and detonated with Cordeau-Bickford. This breaks the rock so that very little secondary blasting is necessary.

All stripping is done by hydraulicing. The water is pumped from the creek at the foot of the bluff by a Hill 4 inch 5 stage centrifugal pump. The pump is direct connected to a 75 H.P. 2,300 volt Westinghouse squirrel cage motor. The pipe line to the top of the hill is a 4 inch welded joint pipe. Taps are put in at regular intervals so that the water can be used wherever needed. A secondary crusher will be installed to take care of the oversize that is being used as bed rock for roads now.

The erection of a lime burning and hydrating plant is contemplated. Work will be started on that operation this spring as the plans are now being drawn. The limestone is to be burned with natural gas, as there is an abundance of gas in this locality. This will give cheap and excellent fuel.

Dr. G. B. Crowe, general manager of the Railroaders' Gas Company is also general manager of this company. Mr. F. A. Madenwald, a graduate chemical engineer is in charge of the operations of the company.

Methods of Checking Fuel Waste

Written Expressly for PIT AND QUARRY by CHARLES LONGENECKER.*

IN ORDER to check fuel waste heat waste must be checked. When fuel is purchased we are really purchasing heat in a latent form. If we can then check our heat losses, less fuel will be required. Literally speaking any waste of fuel, in its raw state, will take place before the furnace, or kiln, is reached. From the furnace on, all losses will be in heat and will of course be measured in fuel. This then divides the subject into:

1. Actual fuel losses—in the raw state.
2. Fuel losses resulting from heat waste.

In this discussion the matter will be treated from the standpoint of a plant for which coal is to be purchased and in which it will be burned in furnaces, or kilns, of any type whatsoever.

There are two phases also to this subject; the personal element and the mechanical. In most treatises the former is given very little space while it is in reality of greater importance. The feature of greatest concern to every industrial establishment is the heat return for every dollar expended in purchasing fuel. Hence the starting point in checking waste is at the mine, and the finishing point is at the stack outlet and also at each point where there is an expenditure of power.

The responsibility for the purchases of fuel lies with the Purchasing Agent. He should know first of all the kind of fuel most suitable for the plant requirements. In some localities there is no chance as conditions make some one fuel the most acceptable. In most localities there is the opportunity to exercise judgment in making a selection. If the fuel to be burned is coal, the Purchasing Agent must know the quality which gives the best results on the plant equipment. He should have a set of specifications which will specify the maximum percentage of ash allowable. The sulphur content of the coal may be vital and should be limited and the percentage of volatile water best suited to the particular type of equipment must be specified. Another feature which is receiving much consideration is the "fusing point" of the ash.

The ash of some coals "fuses," or starts melting, at a much lower temperature than that in other coals. Those coals with a low fusing point ash will form clinkers much more readily than if the fusing point is high. Clinkers in the furnace naturally cause more labor to the fireman and decrease the furnace efficiency. This means fuel loss.

If the Purchasing Agent buys coal which cannot be burned economically, there will surely be waste. Naturally it is the duty of the plant superintendent, or engineer, to advise the Purchasing Agent of the quality of coal desired. In many plants a series of tests is run on different coals to determine the most acceptable.

On receipt of the coal the cars should be sampled and analyzed to see that it conforms to specifications. Coal veins vary and there is, at times, a laxness in separating the slate so that frequent tests are advisable to catch any appreciable deviations.

After the coal is received, it should be conveyed from the cars to the furnace as economically as possible as all power required indirectly puts a tax on every ton unloaded. The cost of unloading varies widely depending on local conditions and the method employed. For a good mechanical conveyor system the cost per ton would average 6 cents. If unloaded by hand the cost per ton would be about 25 cents. It may be as high as 40 cents. Weathering will not affect the heating value of the coal to any very appreciable extent. Spontaneous combustion may cause a very heavy loss.

From the furnace door on the responsibility rests entirely with the superintendent. As all employees are under the supervision of the superintendent, he is accountable for results. As a rule when fuel wastes are mentioned, the burning equipment and attendants alone are considered. In any well managed plant these two factors while important are only items in the balance. Investigations to disclose heat leaks are of a much wider scope. Losses such as leaking steam pipes, exposed steam pipes, bad bearings in line shafting and all uneconomical

*Engineer—Combustion Engineering Corporation.

uses of steam are investigated as such items indirectly cause fuel waste.

The plant superintendent has the following duties:

1. To install proper equipment.
2. Operate this equipment economically.
3. Maintain equipment for high efficiency.
4. Keep equipment modernized.

Item (1) it is assumed is satisfactorily taken care of.

The operation of the plant means, for the best results, the right personnel and the incentive to obtain the best results. In many instances the furnace attendants are regarded more as machines than as beings possessing some degree of intelligence. Incentive is lacking. Again there are plants where the employees do not have at their disposal the accessories necessary for high class operation. There is no argument as to the results that will be forthcoming under such conditions. A well equipped plant will have such instruments as CO_2 recorders, pyrometers, fuel gas analyzing apparatus, draft gauges, etc., so that checks can be made in firing operations. In the larger plants having a metallurgical or chemical engineer, co-operation between this engineer and the operating force is productive of excellent results. The writer, in a recent visit to an industrial plant noted for its economical operation, was informed that tests are run on furnaces every week. Should the test indicate a falling off in efficiency, the cause is determined and steps immediately taken to bring the furnace back to the set standard. These furnaces are in a plant whose product is steel. Such a procedure is not feasible in small plants, but the closest approximation to it is surely advisable.

In some plants a bonus system furnishes the incentive to spur employees to keep up efficiency. This has worked very well and when based on an equitable output is appreciated. If not carefully adjusted the system is likely to cause dissension rather than benefit.

Little need be said concerning the necessity for maintaining equipment in a highly serviceable state of repair. There probably is no piece of machinery as much abused as the furnaces and burning equipment. Why this should be is quite a question. It is easy to burn fuel with mediocre results and hard to burn it at high efficiency. It is so easy to burn that in plants where efficiencies are low, there is not the urge to attain the highest results and hence furnace maintenance lags. If heat waste could be translated directly into money waste, there would be less laxness in maintenance. This applies not only to the furnaces but also to all equipment directly or indirectly connected with the heat supply.

Item (4) advising keeping the plant modernized is another feature which has a local significance, depending on particular conditions. In power plants, stoker fired, very frequently it is wise to purchase modernized stokers and turn in the old equipment on which an allowance can be obtained. This applies, of course, where the stokers purchased are from the same firm that furnished the ones being replaced. The saving in fuel by such an arrangement very often gives a very handsome return on the money invested.

The foregoing covers quite completely the personal element. The mechanical phase will be discussed with attention given to the actual consumption of the fuel. Boiler furnaces and industrial furnaces will be treated separately.

The Prime Movers committee of the National Electric Light Association reports for 1924 on boiler furnaces three outstanding features. The use of air preheaters, the installation of water cooled walls for furnaces and the mixing of furnace gases on chain grate stokers. These features are all showing an increase in efficiency on the boilers on which they are installed. This indicates the trend in fuel saving at present.

Fuel wastes on boilers are attributable to:

a. Excess air in gases.
b. Combustible lost in ashes.
c. Radiation from setting.
d. Sensible heat lost in chimney.
e. Unconsumed fuel lost in waste gases.

The loss due to item (a) can be diminished by exercising external vigilance in firing. In hand fired boilers the coal should be fired frequently and the bed on the grate kept at a thickness found to be most satisfactory. Infrequent firing and a heavy fuel bed mean difficulty in getting the air to penetrate the coal. In putting coal on the grate the volatile constituents are given off first at a temperature varying from 250° to 750° F. These gases are hard to burn as there must be a good mixing of the gases and air and

cold surfaces must be avoided. When the volatile gases are cooled below ignition temperature, they will pass out the stack as smoke. Frequent charges of coal give more uniform conditions and the air supply can be more easily regulated. This is why the automatic stoker gives better results. After the volatile matter has passed away, there remains only the carbon, as coke, with the ash. Holes in the fuel bed allow air to pass through without coming in contact with the fuel. To avoid this the bed must cover the grate. Holes are prevented by keeping the bed uniformly agitated as done on a stoker.

A deficiency of air causes a loss of combustible gases and the loss is noted in item (e). This waste is not as great as with excess air as a rule for generally the trouble is from too much air rather than from a deficiency. If insufficient air prevails for any length of time, the loss will be heavy. Both excess and insufficient air supply are indicated by the CO_2 recorder. This does not record the air supply, of course, but CO_2 is an index to the percentage of air in the gases. The CO_2 should be taken at such a point that the readings will be representative of the gases passing up the stack.

The combustible (b) lost in the ashes is determined by the clinkers in the coal and the unburned fuel lost through the openings in the grate bars. Considerable coke is drawn out and lost when fires are cleaned. These wastes are a question of the personal element unless the grates, etc., have been allowed to deteriorate badly. The loss may run as high as 25 per cent of the combustible. In powdered coal fired furnaces the loss from this source will run from a trace to no more than 4 per cent.

The radiation (c) loss will run from 5 per cent to 10 per cent on an average and may be higher if the setting is not well built and is neglected. Radiation can be reduced to a certain point but cannot be carried too far with solid wall construction. If the heat is not dissipated to a degree, the bricks become too hot and the refractor loss may be too great. The air and water cooled wall construction tends to avoid this trouble.

The greatest loss will be in the sensible heat passing away with the gases discharged from the stack. (d). The heat in the stack is indicated by a thermometer. This heat will vary depending on the boiler rating excess air, etc. In percentage the heat lost will be from 9 per cent to 15 per cent. The temperatures will be from 400° F. to 650° F. This heat may be reclaimed by the use of an economizer or an air preheater.

A further loss will be in the heat required to evaporate and superheat the water arising from the combined and surface moisture in the coal. This may be quite an item if the coal is very wet when charged.

The fuel wastes in industrial furnaces are much the same as in boilers and may be detected in a like manner. An additional loss will result from the heat carried away in the products such as cement clinker from kilns, lime from lime kilns, etc. These losses are hard to reduce to any considerable extent. It can be truthfully said in seeking to reduce full wastes, "Eternal vigilance is the price of success."

Prison-Made Cement Blocks

In order to keep prisoners in the county jail busy the county finance committee of Kent County, Michigan, is proposing to the Board of Supervisors the establishment of a concrete block plant. To this end an old barn at Michigan St. and Division Ave. is being considered. The purchase of necessary machinery would require but a comparatively small investment, it is said.

The property will have to be fenced in and the prisoners, according to Sheriff William L. Smith, can easily be transported from the jail to the cement block plant and there placed under the direction of a competent cement block manufacturer, properly deputized for the responsibility. Gravel can be obtained from the old work farm property on Madison Ave., now owned by the county, which contains large gravel deposits.

Randall Joins Williams Co.

Mr. R. B. Randall, who for approximately six years was Western Sales Manager of Blaw-Knox Company, has been appointed Western Sales Manager of the G. H. Williams Company, Manufacturers of clam shell buckets, Erie, Pa., with headquarters in Chicago. Mr. Randall is very well known to quarrymen, especially in the middle west, and his many years of experience with clam shell bucket work have equipped him to render valuable service to bucket users.

Dust for Rock Dusting In Mines

SOME mine dusts, notably those from lead, mercury, zinc and arsenic ores, are poisonous when they come in contact with the human body, states Dr. R. R. Sayers, Chief Surgeon of the Bureau of Mines, Department of Mines, in Serial 2660, recently issued. The more soluble dusts from these ores are the more dangerous. As an example, men are often badly poisoned when mining carbonate or oxide ores of lead, whereas lead poisoning is rare among men mining only galena, or lead sulphide. Another example is the mining and smelting of mercury, where the hazard has long been recognized. When the ore contains free mercury or the more soluble salts, and when the workings are underground and poorly ventilated, some cases of poisoning occur, but the number is far greater among the employees about reduction plants. Poisonous dusts are rarely, if ever, found in coal mines. The preventive treatment in such cases is much more important than the curative treatment.

Some dusts, when breathed, irritate the lungs and produce a disease known by the general name of "pneumoconiosis." This lung disease is called "silicosis" when it is due to breathing rock dust, especially fine silica, "anthracosis," when due to breathing coal dust, and "siderosis" when due to breathing iron dust. Anthracosis is sometimes called coal miners' phthisis or coal miners' asthma. In addition, the breathing of dust sometimes results in or predisposes to bronchitis and other respiratory diseases.

Silicosis is known to be present in a great part of the hard-rock mining districts of the world. In Australia it is found in both the gold mines and the lead-silver mines. It is found in the gold mines of New Zealand and the tin mines of Great Britain in Cornwall, as well as among gold miners of South Africa. It is found in many of the mining districts of the United States, as in Missouri, Oklahoma, Kansas, Nevada, Idaho, Arizona, and California. It has also been found among the granite workers of Vermont.

In order to determine the suitability of different kinds of dust for rock dusting in mines, in addition to chemical and petrographical examination of dust, studies are being conducted on animals at the Pittsburgh experiment station of the Bureau of Mines. Animals are exposed in chambers to a known concentration of dust. The dusts used as basic types are coal dust, as the type to which men will necessarily be exposed, and quartz dust, as the most dangerous type of dust that might be added for the prevention of explosions. Limestone dust, shale, and kaolin dust are also being tested. From these studies it is found that limestone dust has no more effect than coal dust in the production of fibrous tissue, but the kaolin, or silicate dust, has an effect similar to that caused by quartz dust.

The Bureau of Mines calls attention to the fact that any dust is harmful, if breathed in high concentrations. Coal-miners' phthisis, or miners' ashtma, is now comparatively rare and is disappearing due chiefly to good ventilation in coal mines. In some mines coal dust is produced in large quantities by machine undercutting, by blasting, and by loading. Use of water on the cutterbar, and wetting down the face before blasting and the coal before loading will prevent much of this dust from getting into the air. This lessens the explosion hazard in the mine as well as lessening any possible health hazard.

There is one feature that reduces materially any possible danger from the use of shale. This is the fact that men, with but few exceptions, will be exposed to such dust only for a limited time each day. The Bureau's studies on men suffering from the effects of silicosis in metal mines show that silicosis most frequently occurs among the machine men and the shovelers and muckers. Comparatively few men have been found to be affected among the trackmen, timbermen, or trammers, unless these men have previously workd at machines or shoveling. In the tentative specifications, prepared by the Bureau, attention is called to the fact that dust from pure limestone, dolomite, gypsum, and anhydrite are preferable. The dust from roof shale free from gritty material is extensively used in Great Britain, but not all roof shales are suitable; often they are too sandy or contain too much combustible matter. So far as the Bureau has been able to find, limestone dust is the safest physiologically for use in rock dusting. Gypsum, or calcium sulphate, also seems to be harmless.

Crystalite Reduction Company Works Underground and Open Quarries

Red Granite and White Dolomite Deposits Being Operated Randville Michigan Mill Handles Rock From Both Quarries

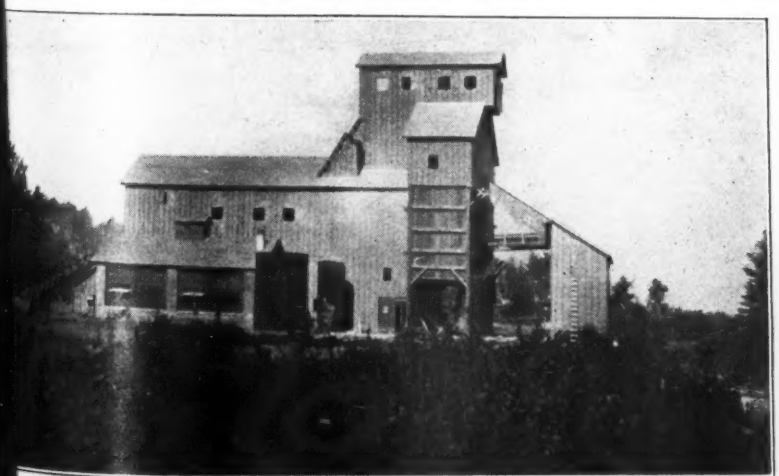
THE Crystalite Reduction Company with general offices at Randville, Michigan, conduct me interesting operations in Dickson County in the Upper Peninsula Michigan. The mill and a large deit of silica dolomite is operated Randville. Three miles east of this posit the company controls a deit of red feldsparthic granite ich is also being quarried. The k from both these quarries is ushed, sized, etc., at the mill in ndville.

The dolomite quarry is an outcrop proximately 1,000 feet long, 350 t wide and averaging 30 feet in ght above the surrounding plane. amond drilling shows that this deit persists to considerable depth. nsiderable of the hill carries a disored rock which is being quarried road purposes. The finer white k is at some depth. This finer ite rock is mined. An incline tun has been built into the hill and pping operations are employed. ersoll Rand jackhammer drills h ⅛ inch hexangular steel, are used in the quarrying operations. All blasting is done with fuse and caps using 40 per cent L. F. dynamite. An Ingersoll Rand 250 cubic foot compressor driven by a Fairbanks Morse 60 H. P. oil engine furnishes the air. The drill steel is shanked and sharpened on a number 33 Ingersoll Leynes air operated sharpener.

All rock from the quarry is pulled direct from the quarry to the mill where it is hoisted up an incline to the receiving hopper by a single drum friction hoist driven from the main mill engine. The quarry cars are of the low side, square box type with end dump. These cars are 36 inch gauge 2 ton capacity and are equipped with roller bearing axles.

Power is furnished for the mill by one Type C. B. U. Primm oil engine of 150 H. P. This is a semi-diesel type engine and is housed in a concrete power house apart from the mill building. It is connected to the main mill shaft with a flexible coupling.

From the receiving hopper the rock is fed by a flexible pan conveyor to a primary breaker which is an 18x24 in.



General View of Crystalite Plant.

jaw crusher. From this jaw crusher the material goes by gravity to a number 4 gyratory from which it is elevated to a sizing screen. The oversize from the screen is returned to two reduction crushers. The undersize passes to a set of rollers for further reduction or is sent direct to the main mill elevator where it is conveyed to the top of the finishing end of the mill.

The elevator delivers the material to a 12 foot revolving screen which takes out three finished sizes. The stucco size passes directly to bins. The other sizes are delivered to bins or to a secondary screen below where it is further sized. All the process up to this point is in closed circuit. A return is made to the rolls in each case until the material passes.

The infished material is loaded direct into railway cars from overhead bins. There are six of these bins each having a capacity of two cars. Rejected material and off color material is shunted by overhead conveyor belts to off color bins across the loading track. There are six of these off color bins each with a capacity of 30 tons. A suction fan collects all dust from the milling operation into a canvas lined bin. Here the dust is exhausted and it is dropped into long bag droppers where it collects. It is then removed and sacked. The air exhausts through the canvas.

From the white dolomite road rock, stucco dash, roofing grit, 40 mesh fines, 20 mesh fines and run of mill fines are marketed. From the read granite stucco dash, roofing grit, 20 mesh and 40 mesh are prepared.

View of Quarry.

The following are offers of C
Crystalite Reduction Company: I.
Rosenberg, President; Edward Copp
Vice-president and Treasurer an
J. E. Hayden, Secretary and Gener
Manager.

Principles of Importing

IMPORTING is a problem involvi
many intricate procedures th
need to be more widely studied an
appreciated. The various trade reg
lations of the many foreign countri
and the import routine of the Unit
States Government custom organiz
tion have constituted perplexing pro
lems for the American business ma
A pioneer work, "Principles of Im
porting," by Wayne E. Butterbaug
is a most welcome book of importa
and instructive information. It
now possible for the business man
have readily available practically a
the information necessary on impor
ing in this one excellent handbook.

The book is divided into chapte
covering the organization of an im
port house, the purchase of goo
abroad, shipping and transportati
details, commercial and transport
tion import documents prepared ov
seas, government documents also pr
pared abroad, organizations and fun
tions of the United States Custo
Service, customs procedure and a
praisement, customs bonds and ent
records, domestic traffic and termi
problems, freight forwarding and di
tribution, and marketing imports.

The appendix to the book contai
valuable reference data concerni
terms and definitions, abbreviatio
average weights and measuremen
entry forms, rate of duty fluctuatio
selected items from the tariff act, co
sular invoice charges, import stati
tics, lists of customs districts a
ports of entry, etc.

The book was written by Mr. Bu
terbaugh while Professor of Tra
portation, College of Business Admi
istration, Syracuse University. A
though intended for the student, t
book will provide for the busine
man a fascinating, instructive a
necessary handbook as the mater
was collected from the actual bu
ness field and is presented in a pr
tical manner.

*Principles of Importing by Wayne E. B
terbaugh. M.S. cloth, 437 pages, Appl
1924, $5.00.

The Annville Stone Company Adopts Unusual Methods

Tunnel Conveyor Inclined at 23 Degrees Proves Successful Model Double Track System Reduces Idle Time to Minimum

WITH a calcium carbonate content of 97 per cent the lime stone quarried by the Annville Stone Company at Palmyra, Pennsylvania, is of the very highest quality. The quarry face is approximately 125 feet high and the pit is now 200 feet wide.

At the present time the loading is being done about 500 feet from the crusher. This crusher is placed on the floor of the quarry. Two six ton side dump cars of special design are used on a double loading track. A Thew type A-1 steam shovel of one cubic yard capacity is used in loading these cars. This shovel is placed so that it can easily reach either track. Perpetual movement of the cars is thus maintained.

The cars are moved alternately by a 7 ton Whitcomb gasoline locomotive. The car on one track is loaded while the other is being moved to the crusher and unloaded. The cars are dumped with an air cylinder into a 36 inch 12 ply Robins belt conveyor. This conveyor delivers the material to the screening and loading plant 100 feet above the quarry floor. This conveyor passes through a tunnel driven upward through the wall of the quarry at an angle of 23 degrees. This tunnel is so located as to bring the position of the crusher in the center of the quarry floor. This is an unusual angle for a belt conveyor and quite a departure from the ordinary methods. However, the Annville Stone Company has demonstrated that it is a practical method. The stone is carried very satisfactorily and with practically no spill.

This plant has produced as much as 1,068 tons of stone in one day, and their daily production over an extended period last year averaged 880 tons. The secret of their record is

Looking Into the Quarry.

continuous production. The plant is as nearly a perfect balance as can be secured. The shovel, cars and locomotive have as little idle time as possible.

Adoption of Ground Cylinders For P Type Air Compressors

IN THE early days of the automobile, the cylinders were bored in the regular way, making the cut as smooth as possible, which was in keeping with the standard practice for such work on larger size cylinders. But the automobile engine being a delicate piece of mechanism and placed in the hands of inexperienced operatives, it was viewed as desirable to take more care with all parts, especially the finish of the cylinder bore, so various tools or devices were devised for the purpose of making the finish as smooth and true as possible.

However, in all of these operations more or less heat was generated, affecting the internal strains of the casting, so when it cooled off it would distort slightly, leaving the bore of the cylinder in most cases out of true, both longitudinally and cross-wise. Considerable effort was expended on these devices, and in the end it was agreed that grinding was the only solution of the problem, because with a grinder very little material is removed per stroke or revolution of the wheel; therefore, heating in this operation is nil, resulting in the cylinder being almost perfectly round and straight when the grinding operation is completed.

For some time only a few of the better makers of automobiles adopted the grinding method of finishing the cylinder bores, but now about eighty to ninety per cent of them finsh their cylinder bores by grinding.

The grinding of compressor cylinders today is about as rare as the grinding of automobile cylinders in the beginning of the manufacture of that machine. But in keeping with the pioneering spirit, the Chicago Pneumatic Tool Company has standardized on the ground finish of the cylinder bores on all of its portable compressors, on account of which the volumetric, as well as the mechanical efficiency is improved.

It is true that it is possible to get a reasonably perfect cylinder from the old method. However, many are convinced that when a compressor cylinder is finished by the grinding method it is about the last word.

Quarry View Showing Shovel At Work.

The Industrial Traffic Department

Written Expressly for PIT AND QUARRY by JOSEPH H. DONNELL*

THERE is a very general awakening going on in the business world, a sensing of the importance of transportation. The average industrial concern is coming to appreciate more every day its dependence on the railroads, and as its continued prosperity is more clearly seen to be indissolubly identified with an efficient handling of its shipping, an added interest is displayed in the industrial traffic department.

The president of the company, his directors, his general manager, the sales manager are asking themselves if indeed a traffic department may not be installed in their own organization in order to improve service, eliminate waste, increase sales, and to make as well as save money, through increased efficiency and economy of operation. The author attempts in this article to explain in a very general way just what a traffic department is and how it may function in the average industrial concern having freight shipments. The brevity of this article permits only a very general treatment of a big subject. It attempts to explain only the outstanding features of the traffic department, to show as it were, the harmonious relation of the traffic department to the general organization.

A subsequent discussion of this same subject on a more elaborate scale will completely unfold the mysteries of the industrial traffic department which have hitherto existed in the minds of many. But it is to be stated now that the industrial traffic department once established will never be dispensed with. It is not unusual for such a department to show tangible returns in dollars and cents of from 50 per cent to 1000 per cent on the money invested in it. Now for our introduction to the Traffic Manager and his efficient little organization.

The Traffic and Shipping Departments are important parts of an organization. Transportation is the "neck of the bottle." The volume of business of any producer, manufacturer or shipper is directly controlled by the ability to secure adequate transportation of raw materials, inbound, and finished products outbound on favorable terms. Manifestly any unfavorable conditions that tend to retard the outbound flow of traffic, must of necessity react adversely upon the activities of the other departments, resulting in the curtailment of production, limitation of sales, and a consequent increase in the general overhead. Thus it is seen that the importance of an efficient Traffic Department cannot be overestimated and likewise the importance of the Shipping Department which should always be a subsidiary of the Traffic Department reporting to the Traffic Manager. Divided responsibility in this part of the business is more than apt to be disastrous. Orders to the Shipping Department should invariably be transmitted through the Traffic Manager as otherwise confusion will prevail and many costly errors result. This is particularly important in times of car shortage and traffic congestion when certain restrictive carloading rules must be complied with and the traffic kept moving despite embargoes. The Traffic Department is intimately related to the activities of all of the other departments; hence it is urgently necessary that the Traffic Manager should harmonize and coordinate the activities of his department with the activities of the various other departments and see to it that he receives similar co-operation from the other department heads. The Traffic Department until recent years has been looked upon purely in the light of a "service" department but now a different idea prevails. Big business concerns and many small ones throughout the country now recognize the importance of the service rendered, but they also appreciate that the Traffic Department is a "money-maker." It is unusual when a Traffic Department cannot pay its own way and show a handsome profit besides, not only in the money that has been made indirectly through an efficient handling of the traffic but in tangible savings effected through claims, revision of freight bills, routing, rate adjustments, use of trap

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cars to eliminate cartage, demurrage, operation of pool cars, storage rates, the opening of new markets through removal of discriminatory competitive conditions, and in many other ways.

Let it be here impressed upon the reader that more money can be lost through an inefficient Traffic Department than through almost any other department, likewise much money can be made by a good traffic organization. The organization of the Traffic Department must of necessity be adapted to the needs of the individual business and the particular activities incident to the handling of that particular tonnage. Some of the more important functions of the Traffic Department are specifically enumerated here with brief comments on each phase of activity.

In the large Traffic Department nearly all of these functions are exercised, whereas in the smaller department only a portion of them may be necessary, or again each phase of service may be rendered but in a modified degree, all of which of course is largely governed by the character and volume of the traffic to be handled.

Functions of the Traffic (and Shipping) Departments

The first duty of a Traffic Manager is to provide his department with necessary filing equipment; his correspondence files should be arranged alphabetically by subjects: "Car Service," "Claims (customers)," "Demurrage," "Reconsigning," "Tracing," etc., and all correspondence filed on the one or more files pertaining to the subject discussed in the letter. It is important to remember that a file in which all letters are filed alphabetically according to the names of the senders or receivers, is not a good system for the Traffic Department.

The Traffic Manager must also provide an adequate tariff file. Tariffs may be secured without change. He should not, however, make the very common mistake of burdening his files with a lot of tariffs he will never have occasion to use. The tariff file is important because railroad rate quotations are often erroneous and if a shipper suffers a loss through an erroneous quotation, he has no recourse against the railroad; therefore a tariff file is a good investment and will pay for itself may times over.

It is often necessary for the Purchasing Agent to know the rates on various commodities from various producing points in order to intelligently place his orders on an economical basis.

The Sales Manager must know the rates to various destinations, in order that he may intelligently quote prices on the firm's products. The freight rate is often a controlling factor in the making of a sale. An erroneous rate quotation may result in any one of several evils.

A contract which would otherwise be profitable may be accepted on an unprofitable basis and an actual loss result therefrom.

A contract may be lost because the competitors rate is lower.

If too low a rate is used and the shipment is sold "delivered," the customer would doubtless be antagonized by a balance due bill from the shipper to cover the difference in freight; therefore, the shipper must absorb the loss or run the risk of antagonizing and perhaps losing a customer.

A card index record of rates frequently used will save much time and duplication of work. In this case, however, it is of great importance that new tariffs and supplements be checked carefully as soon as received and changes in rates noted on the cards.

Rate Adjustments

The Traffic Manager must be ever alert to see that the rates on his commodities are on the correct basis. If his firm's sales are being retarded as the result of unduly prejudicial or discriminatory rates granted to a competitor, the evil should be corrected. The carriers and their standing rate committees should first be appealed to and if they are not sympathetically responsive, recourse may be had to the Interstate Commerce Commission, if an interstate rate; or to a state commission if an intrastate rate.

Do not be satisfied with merely paying the tariff rate. Be sure that the tariffs themselves are correct. Remember that the adjustment of a freight rate may open an entirely new market for your products or may be the instrumentality of holding a market that would otherwise be lost through extreme competition.

Freight Bills

Freight bills should be carefully checked before payment and checks in the correct amounts should be mailed promptly. A record of bills received, corrections made, and checks mailed

hould be kept in the Traffic Depart-ent. This will save time if it be-omes necessary to refer back to pre-ious transactions and will eliminate aving to secure information from the ccounting Department.

laims

The proper presentation of claims gainst carriers will do much to has-n settlement and thus assist in pre-enting the accumulation of large utstanding sums, the interest on hich may total a very considerable mount in the course of a year.

A standard claim form has been rescribed by the Interstate Com-erce Commission and while there is me laxity in its general use, never-heless a great advantage attaches to he use of a good standard form, sup-orted by any documents that may be ecessary to support the various as-ertions in your claim, such as affi-avits, loading or unloading tallys, spection reports, original bills of ding, original freight bills. If un-ble to furnish the originals of the o latter documents, copies of them ill serve the purpose, when further pported by a letter or form demnifying the carrier against loss count of future claim. This letter form is known as a bond of in-mnity. Loss and damage claims d overcharge claims should be filed promptly as possible.

otice of Claim

If it is impracticable to file claim fore the expiration of the filing riod, a letter should be written to e carrier giving notice of claim. is letter should contain an accur-e identification of the shipment, te, shipper, point of origin, con-gnee, destination, contents, car num-r, etc.

ap Cars

A "trap" or "merchandise" car may loaded on the shipper's private sid-g with L. C. L. merchandise for rious destinations and from there moved to the carrier's transfer use, where the car is unloaded, the ntents assorted according to vari-s destinations and reloaded into rough trap cars. When the car s been distributed or "worked," it is more commonly termed, the ls of lading are signed by a joint ent for the several lines involved, d the bills of lading are returned to e shippers who may then forward ginals to the customers and dis-ute other copies as desired.

It will be appreciated that the "trap car" saves many dollars every day in cartage or drayage charges, as it eliminates the necessity of having to team L. C. L. freight to the various railroad local freight depots. Trap cars may also frequently be used on inbound L. C .L. traffic. There is frequently no charge for switching an outbound trap car but where a charge is assessed it is usually very nominal.

Switching

In the case of an industry with a private siding an arrangement should be made with the yardmaster at the carriers "distribution yard" to switch cars into the plant as needed. At least one switch a day should be had in order to "place" the late inbound arrivals and to "pull" the various outbound carload shipments and trap cars. Switching charges on "line haul" freight are usually absorbed by the carriers, in fact nearly always included in the "line haul" rates. Local and intra-plant switching is charged for. When an industry performs its own intra-plant switching and uses its own locomotives and equipment, an allowance is made the industry by the carriers to in some measure offset the expense involved.

Demurrage

Demurrage is an important item of expense to the industry which has outgrown its track facilities and must therefore hold cars in the carrier's yard or on its own siding longer than would otherwise be necessary. A lot of demurrage is also unquestionably due to unskillful methods of handling.

A carrier assesses demurrage charges against equipment that is held longer than 48 hours, to insure the quick release of the car. It is not considered as a source of revenue for the carriers but strictly a penalty charge.

When a shipper finds that he is having to pay a large amount of demurrage, it is probable that he would benefit by effecting with the railroad serving his plant, an "average agreement" under which he receives one credit for all cars released within 24 hours, a debit for each car each day that it is held beyond 48 hours free time period, and which credits and debits are totaled at the end of the month. If the credits exceed the debits, the shipper has no demurrage to pay, but if the reverse is true and the debits exceed the number of

credits, demurrage must be paid, predicated on a specific scale.

It is quite essential that cars be loaded and unloaded promptly and that accurate car records be kept as otherwise demurrage charges will become a source of much, perhaps unnecessary, expense.

Car Reports

Daily car reports should be compiled by the Traffic Department and copies furnished to the general manager, sales manager, production manager, purchasing agent, warehouse superintendent and other interested departments. These reports show the number of cars in transit, the number in town awaiting placement and the number on siding. The contents of the cars should be specified, thus enabling all of the departments notified to gauge their activities properly. The sales manager would know what stocks needed to "move," the production manager would be informed as to the amount of raw materials coming in, the warehouse manager would be thus enabled to prepare necessary space to receive the incoming tonnage, etc.

Reconsigning

Frequently it is desirable to change the destinations of cars while in transit. This practice is called "reconsigning" and much good may be accomplished by an intelligent and efficient application of the reconsigning rules.

If a customer cancels an order that is in transit and it can be sold elsewhere, the car may be reconsigned in transit to the last buyer and the through rate to final destination will apply, plus a nominal reconsigning charge, thus doing away with the necessity of having to pay a combination of local rates. Of course, reconsigning may only be practiced when no "back haul" is involved.

Routing

Routing is an important function of the Traffic Department.

Shipments should be routed so as to combine good service with the lowest rates, unless there are times when the customer has his own reasons for specifying a route that requires payment of a higher rate or via which the service is not good.

All routing instructions received from the customer should invariably be reproduced upon the order when it is written up, in order that the customer's wishes may be adhered to.

If the customer specifies an undesirable route through ignorance of the attending conditions, it is probable that he will change the route when the facts are brought to his attention. He should at least have the opportunity of doing so.

Tracing

Shipments that are unreasonably delayed in transit, whether carload or less-than-carload, should be vigorously traced and reported on to the customer. It is very unwise, however, to put a tracer on a shipment too soon, as this merely serves to burden the railroad tracing clerks with a mass of unnecessary work which prevents them giving you, and others, the very service you desire.

Customers' Claims for Freight

Customers' claims should be handled promptly. If a shipment has gone forward to a customer, freight "collect" instead of "prepaid," the customer is probably not very favorably impressed by the error that resulted in his subsequent annoyance and additional trouble involved. Therefore his claim when presented, if a just one, should be acted on and immediately honored in order to overcome the bad impression caused by the mis-billing of the shipment.

Side Tracks

The securing of private sidings on favorable terms is another important duty of the Traffic Manager.

Export Traffic

The Traffic Department of any exporting house should be ever awake to securing the lowest "going" rates on its firm's products for shipment overseas. The steamer lines plying between the United States and foreign ports are not controlled by the Interstate Commerce Commission; hence their rates are governed largely by competition. As a matter of protecting themselves against the evils of rate wars and the dire effects of unbridled competition the steamer lines organize what are known as "Conferences," and the majority of the so-called "standard" lines operating certain "services" in competition with each other will through the medium of a "Conference" agree to maintain rates at a certain figure on each commodity. Their competition thence becomes a matter of service rather than of rates. Occasionally some line, not a member of the Conference, will through the medium of lower rates make such inroads into the traffic of conference lines, that it becomes ne

essary to suspend the agreements for a while and throw the rates open to competition which usually has the effect of forcing the recalcitrant line into the "Conference" or precipitates a rate war, which though very advantageous to shippers is deplored by the steamer lines. It will be readily appreciated then, just why an export shipper must be currently well informed as to all developments in the ocean rate situation and able to anticipate such moves on the part of the "Conferences" and steamer lines. Manifestly if when one of these rate "breaks" occurred, he were to find himself "tied up" with a "time" contract at higher rates, his competitors would take advantage of the occasion to underseli him in the foreign markets and to take from him business that has probably cost him much time, effort and money, to secure and get established.

Export declarations must be executed on foreign shipments and frequently the country to which the shipment is going has special forms of Consular invoices which are required to clear the shipment through the customs at destination. The various rules of the many foreign countries are so diverse, that it behooves the American exporter to have on file and readily available all of the information needed.

Export shipments must be distinctively marked to facilitate identification and comparison with the shipping documents. They should also be covered with Marine insurance.

Export shipments moving from the interior to the Seaboard may move either on inland bills of lading to the seaboard and "steamer" bills of lading beyond or may move straight through, in many cases, on a through export bill of lading. In any event the bill of lading should show a notation "for export" in order that the shipment may receive the advantage of the inland "export" rates which in many cases are provided and which are lower than the inland "domestic" rates.

Packing requirements for export traffic usually differ from domestic requirements. For example starch in domestic transportation may move in single bags of 280 pounds each, but when exported must be packed in double bags of 140 pounds, or in bags with a paper lining to combat the absorption of moisture and to better withstand the wear and tear of the several "handlings" and strain caused by the steamer's "tackle," while loading.

An adequate car supply must be secured but care must be taken to avoid ordering too many cars as the payment of demurrage would result. This must be worked out to a nicety and constantly watched.

If a company distributes through warehouses located in various parts of the country, the Traffic Department should be sure to secure the lowest available storage and cartage rates, consistent with good service. Care should be exercised in the selection of the warehouse as to its facilities and location. Storage bills should be carefully checked and "consigned stock" records carefully maintained.

"Pool" cars should be used where possible in order to secure the advantage of carload rate on a number of less-than-carload orders shipped in one car. Where the orders are for different towns but in one general locality, it is frequently advantageous to make up a "pool" car for a town centrally located to the several destinations and thus obtain the carload rate to that point plus the less carload rates beyond.

Frequently a car may be loaded with two part car shipments, the first for a point directly intermediate to the destination of the latter. In this case mark the bill of lading "Stop at ——— for partial unloading," thereby getting the advantage of a saving in the freight charges on account of the shipment having moved as a carload to the first destination.

Concentration and transit privileges must be taken advantage of whenever possible. These privileges enable the concentration of less-than-carload shipments at central points for consolidation into car lots and allow milling, dressing, storage, etc., in transit of many products at the through rates, thus enabling the shipper to avoid paying local rates into and out of the transit points, which would of course greatly exceed the through rates. The transit charge is always very nominal.

The Traffic Manager should closely co-operate with the factory superintendent to see that the proper system of warehousing is used in order to cut down lost motion and to insure quick and economical ingress and egress of products to and from the loading docks. Large amounts can be saved through this method of eliminating

unnecessary "handling," which is always very expensive.

Automatic conveyors and devices, including "lift" trucks and similar equipment should be employed to facilitate rapid handling and to save labor.

The shipping department under the supervision of the Traffic Manager's office should keep a close check on the trucks employed in making city deliveries, in order to increase their efficiency through scientifically planned routing, etc.

A study should be made of containers and only those containers that are scientifically adapted to use in connection with a firm's products should be used. Containers should adequately protect the product but should not be so constructed as to result in excessive freight charges. The container specifications of the Consolidated Freight Classification should of course be complied with, as otherwise the shipment would be penalized and an additional charge added to the freight.

Wherever standard forms may be used to take the place of letters a great economy of time and money can be affected.

In the shipment of fresh meats, fruits, vegetables and other perishables, cars must be properly precooled in some cases, iced and when necessary re-iced in other cases.

In the shipment of vegetables during the extremely cold weather it is frequently necessary to use "heater" cars.

All of these things require expert knowledge and constant vigilance on the part of a highly efficient traffic and shipping organization and their effective execution will play a very vital part in the growth and prosperity of any business that ships or receives freight of any kind. The traffic department may consist of one man or a hundred men, depending upon the volume of business to be handled. In any event it is the one department that a business may maintain without expense.

A Steel Body With a Renewable Floor

WITHOUT exception, everyone who has been in the contracting business for a number of years has watched and been a part of the transition from the various types of horse-drawn dump wagons to the present efficient motor truck. When the motor truck with its all steel body first gained recognition as an efficient and economical medium for general hauling, many soon found that in loading rough stone from the quarry, or during general excavation work where rocks were prevalent, when an overhead loader dropped a good sized jagged rock upon the steel floor, the impact would not only leave a permanent indentation but would create strains that, in turn, distorted the entire body.

After a series of costly experiments; always changing gauge of the floor steel to something heavier until finally, from one-eighth stock, the bed plate measured, in many instances, five-eighths of an inch in thickness; it was found that, due to the lack of resiliency in sheet steel, nothing lighter than heavy armor plate could resist the shock. Finally a body was built for a contractor in New York that was the equivalent of placing an all steel body inside of a heavy all wood body. The result of this innovation was very gratifying, and it seemed to have solved the problem. The heavy two-inch planking beneath the steel floor not only prevented excessive denting of the steel; but due to the resistance and resiliency of the hard wood, the body instantly returned to its normal dimensions following each shock. After continuous use, however, it was found that this type of body was expensive when it came time to renew the floor, for the simple reason that it practically meant renewing the entire steel lining; the reason being the inner steel body, or lining, was to all purpose a one-piece job.

The final answer has been worked out by the Mack Truck body builders in the form of construction that places an independent layer of heavy creosoted planking on top of the original steel floor, above which is an additional reinforcement. In other words, the planking, with its protective covering of steel plate, rests upon the original floor of the all steel body, and the whole is bound together by a series of flat headed countersunk bolts. This construction, as can readily be seen in the illustration, makes it possible to renew the flooring by simply removing the fastenings and bolting down a new combination. These bodies have been in actual test for some time, and have, in every instance proven extremely satisfactory and economical.

Crushed Stone Tests

By A. T. GOLDBECK*

THE TREND in the writing of present day highway specifications is toward definiteness with respect to every item involved. Materials are described in as much detail as our knowledge seems to warrant. It has been found that much contention on the part of the engineer, the contractor and the materials producer is saved whenever one knows definitely what is expected of him. Specifications for materials involve a description of the materials in terms of specific qualities which those materials must possess in order to be satisfactory for the particular type of construction contemplated and it is generally the case that where there is much deviation from the specifications, unsatisfactory results are likely to occur.

In general, there are two properties which crushed stone must possess for its successful application to any particular type of road construction. (1) It must be crushed to the proper size and (2) it must have physical qualities which make for enduring construction.

Crushed stone was first used to a considerable extent in the building of the macadam type of road in the old days of steel tired traffic. As early as 1878 our first physical test was developed in the French School of Bridges and Roads, primarily as a test of the suitability of stone, for waterbound macadam construction. Later the Dorry test for hardness of rock was likewise developed in France, again primarily to determine the suitability of rock for waterbound macadam. In this country other tests were developed by the late Logan Waller Page in the Office of Public Roads, Department of Agriculture. These tests were the Page impact test for determining the toughness of rock, the cementing value test to determine the binding value of rock dust and the absorption test.

Lately a new test has been developed, although not perfected, the so-called accelerated soundness test for rock. Some have a hazy idea of just what the above mentioned tests are and what they aim to accomplish.

*Chief, Division of Tests, U. S. Bureau, paper presented before National Crushed Stone Convention, January 12, 1925.

The Deval Abrasion Test. The Deval abrasion test is conducted by placing a sample of 50 pieces of uniform sized stone in a cylinder inclined at an axis. As the cylinder is revolved, the pieces of rock and particularly their corners are worn to dust and the amount of wear is expressed in percentage of the original sample. The French co-efficient of wear equals 40 divided by the percentage of wear. Both terms are used and should not be confused.

The Dorry Hardness Test. In the Dorry hardness test a cylinder of rock is held against a revolving disk upon which dry crushed quarts is fed and the amount of wear is determined.

The Toughness Test. In the toughness test a 1-inch cylinder of rock is subject to the impact of a hammer falling on the round ended plunger resting on the specimen. The toughness of the rock is expressed in terms of the height of fall of the hammer when failure takes place.

Cementing Value Test. In the cementing value test the rock powder is ground with water in a ball mill compressed into a cylinder which is dried in an oven and finally broken under a special impact machine, whose hammer falls from a constant height of 1 centimeter until the specimen fails. The number of blows required to produce failure indicates the relative cementing value of the rock.

The Absorption Test. The absorption test consists simply of determining the amount of water a rock will absorb in a given time.

All of these tests were designed in the days of waterbound macadam and they have been criticized as being unsuitable in their application to our present day uses of rock in Portland cement concrete, bituminous macadam and bituminous concrete pavements subjected to rubber tired traffic. A discussion of this particular point will not be amiss. In the days of waterbound macadam and steel tires the rock was subjected to surface abrasion by passing vehicles which created a considerable amount of dust and was likewise subjected to internal wear due to the grinding action of one rock on another. The dust created served to bind the road together, the dust of some rocks possessing this property more than others.

This was the sole reason for designing the cementing value test. At the present time the cementing value test for rock has practically no significance, for we can no longer depend on the cementing value of the dust to hold the road together. Under rubber tired traffic very little dust is formed by abrasion and this is rapidly dissipated. There is little excuse, then, for the cementing value test in present day specifications covering crushed rock. In bituminous macadam of the penetration type the action of rubber tired traffic still produces internal wear, particularly of the stone not covered with bituminous material. There is still need, therefore, for some kind of an abrasion test such as the Deval test. In the bituminous concrete type of pavement the surface stone is still subjected to forces of high intensity such as impact from high speed traffic and the action of tire chains, and it is likewise our belief that there is the possibility of considerable internal wear when the stone is too soft. Again it will be seen that there is still need for tests to determine the strength of the rock. The Deval test and the Toughness test both accomplish this purpose. In our concrete pavements the stone is surrounded by Portland cement mortar which prevents any movement and which offers considerable protection. The stone is thus subjected only to the abrasive action of traffic and to a slight extent to the disintegrating influence of the weather. It has been found both in service and by means of specially conducted tests that when the stone in the concrete pavement is so soft that it wears faster than the mortar, this is an undesirable condition, leading to uneven and rapid wear, especially in our northern climates where tire chains are used. We need have no fear of abrasive wear from rubber tired traffic alone. Some of these old fashioned tests, then, such as the cementing value test and Dorry hardness test no longer have any particular significance when applied to crushed stone as now used in highway construction.

On the other hand since stone under present day traffic conditions must still possess strength, durability and resistance to abrasion, our tests which measure these properties are still applicable. The Deval abrasion test and the toughness test for rock still have high value though undoubtedly they might be improved upon. It is for the above reasons that our highway specifications for rock still contain clauses which require a specified maximum percentage of wear or a certain minimum toughness. The toughness test has been largely supplanted by the more simple Deval test in many laboratories, for it has been found in general that the Deval test serves every purpose. It is a toughness test and an abrasion test combined. Some specifications further safeguard the quality of the rock through the use of both the toughness and Deval test.

I have mentioned two other tests, the absorption and the soundness test. The absorption test records the amount of water which will be absorbed by the rock. Ordinarily rocks which have a high absorption are soft and are not apt to withstand constant repetition of frost action. The accelerated soundness test is a test which is designed to simulate the destroying action of repeated freezing and thawing. As at present performed, the rock is immersed in a saturated solution of sodium sulphate for twenty hours, dried for four hours in an oven and this treatment repeated five times. Rocks which are not durable under frost action will disintegrate or crack under the action of this test. Sodium sulphate crystalizes in the pores of the rock, gradually expanding and destroying the structure much after the action of ice. At the present time the indications are that the test is too severe. A rock which fails in this test will not necessarily fail in service, but apparently the test does detect rocks which are likely to fail under service.

Those engaged in highway construction cannot overlook the fact that many problems in economics are involved and this is especially so in the use of materials. It is for this reason that specifications for materials to be used in similar types of construction differ in the different states. It goes without saying that in some localities it might be advisable to use material which in other states would be regarded as inferior, for ultimate economy would thereby result even though the road did not possess the highest lasting qualities. Crushed stone is now used for the most part in macadam construction which will later receive a surface treatment of bituminous material, in bituminous macadam, in bituminous concrete and Portland cement concrete pavements.

Generally where waterbound macadam is built, to be later surface treated, heavy traffic is not expected.

Here good practice would not as a rule allow stone with a percentage of wear of more than 6. Economy demands that a softer stone be used in certain localities. For bituminous macadam a percentage of wear of more than 6 should not be used, for bituminous concrete, which ordinarily is of a more expensive type laid on a more expensive base than bituminous macadam, the percentage of wear should be not more than 5.0, and in order to reduce the liability of the stone to fracture, an additional requirement for toughness is used, the value for toughness being set at not less than 6.0. Instances are available where disintegration of bituminous concrete seems to have results from the use of too soft a stone. Many engineers specify a lower percentage of wear for trap or granite than for limestone for a given type of construction. The reason for this is that trap and granite are naturally more resistent than limestone so that granite showing a percentage of wear greater than normal for that type is likely to be partially disintegrated or of otherwise inferior quality even though the actual wear as shown by the tests is the same as the limestone. In connection with waterbound macadam construction certain types of rocks, such as quartzites, gneisses and schists, generally, cannot be used successfully due to the difficulty of binding such materials.

In order to study the physical properties of stone which would render them suitable for concrete road construction we conducted a rather elaborate test a few years ago in which 62 different kinds of concrete containing imported aggregates were subjected to the abrasive wear of a special rubber tired vehicle operated at 20 miles per hour. The vehicle was guided by means of a track so that the wheels came continuously in the same trackway. In this way the test was accelerated. The vehicle was first equipped merely with solid tires and after running it for thousands of trips we have come to the conclusion that so far as rubber tired traffic alone is concerned the present wear on concrete roads is not an important factor in limiting the life of the road.

In many sections of the country, however, there are conditions which make for abrasive wear, such as the use of tire chains, and grooves have been worn in concrete pavements due to this cause. Our vehicle was therefore equipped with tire chains and the test repeated and pretty soon the surface wear became very appreciable. This test has been described in detail, but the important points to be brought out at the present time are:

1. That rubber tired traffic alone produces no appreciable wear on a concrete pavement.

2. That tires equipped with tire chains cause appreciable wear. This wear is practically independent of the hardness or type of coarse aggregate so long as the coarse aggregate has at least the same resistance to wear as the mortar. When softer aggregates than these are used, the wear on the pavement increases as the stone becomes softer. So far as we have been able to determine, the percentage of wear in the Deval abrasion test which results in equal wear in both stone and mortar is approximately 7.0.

3. From the standpoint of abrasive wear alone there seems to have been little choice in this test between crushed stone and gravel. It should be emphasized, however, that abrasive wear is but one of several factors which should influence the choice of an aggregate. The questions of structural strength of the concrete, relative liability to cracking and subsequent spalling and consequently high maintenance expense must also be considered. It appears from these tests that notwithstanding the fact that the Deval abrasion test was originally designed for macadam road construction it seems to have considerable significance for the specification of rock for concrete road construction.

While discussing the question of physical properties of coarse aggregate for concrete roads it will be well to consider the use of stone screenings as a fine aggregate in concrete. In general stone screenings are characterized by the presence of an excessively large amount of dust and an excessively large amount of very coarse particles with a corresponding lack of particles of intermediate size when compared with the grading of good concrete sand. One of our tests for the suitability of fine aggregate for use in concrete is the so-called strength ratio test in which the tensile strength of 1.3 mortar briquets is compared with the tensile strength

of Ottawa sand mortar briquets made at the same time. The ordinary assumption is that when these strengths are equal, the sand is an excellent concrete material and in general this holds true. When the same test, however, is made with stone screenings it is almost invariably the case that the briquets, made from stone screenings test higher than Ottawa sand briquets, but notwithstanding this fact, it is generally true that concrete with stone screenings as the fine aggregate is apt to have comparatively lower strength than where sand is used. Unfortunately it is also true that in many cases where stone screenings have been used as the fine aggregate, the concrete has not been resistent to the weather. Particular trouble has been had with limestone screenings, and no doubt this is true primarily because the concrete has been lacking in density due to the poor grading of the screenings. I feel that if it were possible for crushed stone producers to turn out screenings with the same mechanical grading as a good grade of concrete sand there would be no question of their suitability for use.

No doubt many have noticed in the technical literature of late that more and more emphasis is being placed on the question of uniformity of concrete. Concrete structures, including highways, are proportioned on the assumption that the concrete has a definite assumed strength. Thousands of concrete cores have been drilled from concrete roads and the results in many cases show a great lack of uniformity in the concrete, in some cases the crushing strength varying as much as 100 per cent in the same job. It is not sufficient that the concrete have an average strength equal to that for which the structure was proportioned when it is so much weaker than that in many spots, and for this reason it is highly important in the minds of engineers that everything

TABLE I.

The following table illustrates the effect of variations in the grading of coarse aggregate on the consistency of concrete:

Results are based on actual Tests of 1:2:3 Concrete.

Aggregate graded as follows:

Water required for a given consistency.

	Crushed Stone					Gravel				
	¼-¾	¼-1	¼-2	¾-2	1-2	¼-¾	¼-1	¼-2	¾-2	1-2
Water required for a given consistency. (gallons per bag cement	8.0	7.7	7.3	7.0	6.8	4.5	4.4	4.1	3.9	3.8
Consistency resulting when a constant amount of water is used (slump, inches)	1	2	3	4	6	2	3	3	6	7

TABLE II.

Maximum Permissible Range in Mechanical Analysis for Each Size.
(Percentage by weight passing laboratory screens.)

Designated Size	Diameter of Screen Openings, Inches										
Inches	¼	½	¾	1	1¼	1½	2	2½	3	3½	4
*0–¼	85–100	100	.....	.....	.....	.....	.....	.....	.....	.....	.....
*0–½	15–75	95–100	100	.....	.....	.....	.....	.....	.....	.....	.....
*0–¾	15–75	.....	95–100	100	.....	.....	.....	.....	.....	.....	.....
¼–½	0–15	95–100	100	.....	.....	.....	.....	.....	.....	.....	.....
¼–¾	0–15	25–75	95–100	100	.....	.....	.....	.....	.....	.....	.....
¼–1¼	0–5	.....	40–75	.....	95–100	100	.....	.....	.....	.....	.....
¼–2	0–5	5–25	.....	40–75	.....	.....	95–100	100	.....	.....	.....
¼–2½	0–5	.....	10–25	.....	40–75	.....	.....	95–100	100	.....	.....
½–1	0	0–15	25–75	95–100	100	.....	.....	.....	.....	.....	.....
¾–1¼	.....	.....	0–15	25–75	95–100	100	.....	.....	.....	.....	.....
1¼–2½	.....	.....	.....	.....	0–15	.....	25–75	95–100	100	.....	.....
†2½–3½	.....	.....	.....	.....	.....	.....	.....	0–15	25–75	95–100	.....

*Designated sizes 0-¼, 0-½, and 0-¾, when used as screenings in waterbound macadam road construction shall conform to the following additional requirement: Passing No. 100-mesh sieve, 6-12%.

†The lower limit for designated size 2½-3½ may be changed to 2", when necessary to utilize the product of a crusher producing designated size ¼-2".

The upper limit for designated size 2½-3½ may be changed to 4" in the case of very soft stone or light or porous slag.

possible be done to bring about uniformity of strength. Already several of the state highway departments have begun to take measures aiming at more uniform concrete. As an illustration of this Iowa is now carefully weighing both sand and stone entering into concrete road construction. Other states although still measuring by volume are taking into account the fact that the volume of sand may vary 25 per cent due to variable moisture content. Again, devices are beginning to appear which aim not only to insure more exact measurement of the fine and coarse aggregate but also of the water used for mixing. This is one of the decided variables and one which results in great lack of uniformity.

There are very few engineers who realize the part the coarse aggregate plays in influencing the water content in a concrete mixture and therefore the strength of the resulting concrete. Whenever the gradation of the coarse aggregate changes during the progress of the work, this necessitates changes in the amount of water required to produce a given consistency of concrete. To illustrate the effect of gradation on the consistency, tests were made on 1:2:3 concrete using both limestone and gravel as the coarse aggregate. The results are indicated in the following table (Table I). It will be noted that changes in the gradation of the coarse aggregates produced a marked effect on the workability. For instance, a certain amount of water produced a slump of 3 inches when a ¼ inch to 2 inch normally graded aggregate was used, whereas, exactly the same quantity of water produced a slump of 6 inches when the material between the ¼ inch and 1 inch screens was removed. On the other hand by maintaining a constant consistency, which of course should be the aim of every mixer operator, fully ½ gallon less of water per bag of cement was required when the stone was graded from 1 inch to 2 inches than when normally graded from ¼ inch to 2 inches. In a 6-bag batch this would mean a change of 3 gallons in the measured water content and of course correspondingly a large difference in strength. Thus producers of stone can aid in this movement for more uniform concrete by maintaining an absolutely uniform product during the progress of the work. The ideal condition, so far as the coarse aggregate is concerned, is that of uniformity of grading and this is an ideal which at the present time is not being generally attained. No doubt this is due in part to the present custom of screening aggregates at the producing plant and then more or less inefficiently mixing the various sizes together in a car before shipment. Possibly if more accurate methods were used for combining the screened sizes than those now used, the desired results would be obtained. One possible solution for obtaining more uniformly graded coarse aggregate is that of shipping the screened sizes separately to the central proportioning plant stock, piling them there and later combining them in the desired proportions. It is recognized, however, as one of the difficulties in this proposal that ordinarily it is hard to find sufficient space to stock pile separate sizes and of course additional time is required to measure the sizes separately at the proportioning plant. I leave this idea of uniformity with the producers. It is one which they should be prepared to meet.

In addition to quality requirements for crushed stone, specifications call for grading of the stone in a particular manner for specific types of construction. Unfortunately engineers in different states have different conceptions of what constitutes a proper size of material for the same kind of work, and this of course leads to needless expense in the producing plant which is called upon to supply materials to several adjacent states. It would be ideal and highly economical if a definite standard of sizes could be set up which might be followed by the users of crushed stone. The Road Materials Committee of the American Society for Testing Materials is now at work on the production of such a standard. The standard of sizes proposed by this committee which is designed to meet the requirements of the various types of construction now used is given in the following table. (Table II.)

It will be observed that the sizes are stated in terms of laboratory screens. This procedure is followed rather than that of stating the size in terms of the size of the commercial revolving plant screens simply because there are many factors in plant practice which affect the size of the screened stone, whereas the laboratory practice is standardized. It is the individual producer's problem to run his plant in a manner such that the

laboratory screen requirements will be met. I have no doubt that the various laboratories will be glad to work with producers to this end for procuring the desired result. It is desirable that all producers submit criticisms of this proposed standard, preferably through the representative on the Road Materials Committee. One should be appointed if he does not exist.

In conclusion, I would again emphasize the great need of your working to the end that the greatest possible uniformity of product will be assured during the progress of any given piece of construction.

New Incorporations

Calaveras Cement Company, Wilmington, Delaware, has been incorporated for $14,000,000 to deal in Portland and other cements.

Pacific Lime and Cement Corporation, Dover, Delaware, has recently been incorporated for $20,000,000 to deal in cement of every kind.

Concrete Interlocking Tile Corporation of Long Island, Wilmington, Delaware, has been incorporated for $100,000 to deal in cement.

Washington Exploration Corporation, Port Washington, L. I., N. Y., has been incorporated to deal in sand and gravel by Lester E. Dodge, for $3,429; Warren, Gordon, $3,051; and Philip Gray, $15,067. Judge Campbell has appointed Louis J. Castellano receiver, in bond of $2,500.

River Sand and Gravel Company, North Chattanooga, Tennessee, capital stock $100,000. Incorporators: Floyd L. Best, Leland Thompson, Morris Sherman, M. V. Wilson, E. C. Moses.

Beverly Sand and Stone Company, Knoxville, Tennessee, have changed their name to Holston Quarry Company of South Carolina and increased their capital stock from $50,000 to $100,000.

C. E. Rock Company, Inc., Wilmington, Del., have recently been incorporated to deal in products and commodities with a capital of $100,000.

Plymouth Rock & Sand Company, Inc., El Monte, California. Directors: Paul D. Green, John W. Loy, J. C. Booth, all of L. A. et al. Capital stock $60,000, subscribed, $50. Attorney, John B. Haas, L. A.

Oxford Sand and Gravel Corporation, Syracuse, N. Y. has been incorporated for $50,000 by W. L. Sporberg, A. G. Seitz, M. D. Winsor. (Attorneys: Nash, Britcher & Echel, Syracuse.)

Kansas Portland Cement Company of Bonner Springs, Kansas, has been given authority to increase their capital from 10,000 no par shares to 30,000 no par shares.

Shawnee Stone Company, a Delaware corporation, qualified in Indiana, has been incorporated in this state for $100,000 to quarry and deal in stone. Agent, John L. Torphy, Bloomington.

A Novo Bulletin

The January issue of *Novo Power* features Novo Road Builders Equipment. Illustrating this story is an engraving of the sand and gravel plant of W. L. Johnson at Albion, Ind., and a view of a Novo E F H Air Compressor Outfit furnishing air to operate two rock drills on road job near Asheville, N. C. Other illustrations of Novo equipment are shown "close up" and on the job.

Reynolds Equipment Company Issues New Bulletin

Reynolds Equipment Company, 343 South Dearborn street, Chicago, has issued Bulletin No. 104. This company buys, sells, rents, trades and rebuilds equipment of all kinds. It also takes equipment on consignment, to rebuild to sell it, or else will store and rebuild equipment for the owner. The folder catalogs a long list of engineers' and road builders' equipment.

Scott Valve Note

O. L. Chapman has joined the sales organization of the Scott Valve Manufacturing Company of Detroit. Mr. Chapman is widely known in the industrial field throughout the United States, and will devote his time to the application of valves to manufacturing plants and similar lines of industry.

Babbitts and Babbitting

By W. F. SCHAPHORST

IN VIEW of the fact that from 20 to 30 per cent of the power given up by engines and motors is generally absorbed by bearings in the form of friction, it is very important that the bearings be properly babbitted. Each bearing, whether ball bearing, roller bearing, or plain, absorbs a certain amount of power. Multiplying that power by the number of bearings throughout the plant and the total loss will probably astound you.

If they are plain bearings, do a good job of babbitting, then oil the bearings properly, and the difference in drag of each bearing will be immediately noticeable and probably measureable. Multiply that difference by the number of bearings in the entire plant and you have the total saving in power. The saving in wear due to proper babbitting is often just as important as the saving of power. Furthermore, the less the friction the less the oil consumption—another saving and often a very important one. Of course, no surfaces are perfectly smooth. They may feel smooth to one's finger tips but nevertheless under a magnifying glass the surfaces will be found to be decidedly rough with multitudinous small hills and valleys all over. The good babbitt metal is that metal which will produce a very smooth mirror-like surface on which the hills and valleys will be reduced to the very minimum.

Contrary to most beliefs, lead would make a very good anti-friction material if it weren't so soft. Its coefficient of friction is very low and it can be plastered down so that the hills and valleys are almost invisable even under the most powerful microscope. To make the lead harder so that it will hold up the load antimony is usually added. And then copper and tin are added to create both toughness and hardness. In addition, tin acts as a solder in uniting all of the metals.

The purchaser of high grade machinery should see to it that no bearing in any machine is subjected to a load greater than 2,500 pounds per square inch. That, remember, is the very maximum. For ordinary operation keep the load below 1,500 pounds per square inch and you can be pretty sure of long service provided the correct babbitt metal is used and provided the bearings are properly lubricated.

There is a babbitt commonly used known as "genuine babbitt" which is very strong and tough, being made up of 80-90 per cent of tin. But in modern bearings we seldom have anything but compressive stresses within the babbitt so why should the babbitt contain so much tin? It may therefore be generally regarded as good practice to reduce the percentage of tin as much as possible. Bearing metals cost considerably less and naturally give better service if they contain a larger percentage of lead and just the right amount of tin. They will stand higher speeds and absorb less power. In a great many actual instances genuine babbitt bearings have given trouble and have been replaced by lead base babbitt and no more trouble has been experienced.

As for price, however, never buy a bearing metal on a cost basis. First think of the bearing—of the transmission problem and then pick out the metal that best cares for the problem.

The following metals are the ones that are the most used in making babbitts: lead, tin, antimony, copper and bismuth. The principal trouble with lead is that it melts at a trifle over 600° F. and as already stated it is very soft. However, it has a lower coefficient of friction than any other metal, being in that respect similar to graphite. To make the bearing metal tougher, stronger and more dense, add tin. Tin, however, lowers the melting point and increases the friction. Tin melts at a temperature close to 450° Fahr. Unlike tin, antimony raises the melting point. It makes the bearing metal still harder. Unlike tin, it also reduces friction. By reducing friction the tendency to heat is also reduced. Antimony melts at a little less than 1,200° F. It tends to make the metal brittle. All in all antimony is a "pretty good metal" for bearings. Copper increases the melting point and makes the metal tougher and harder but at the same time, surprising as it may seem, it increases the friction. Its melting point is the highest of them all, being over 1,900° F. Copper should be used very

sparingly in bearings, and it generally is.

To prevent shrinkage of the bearing metal, add bismuth. Bismuth also reduces friction. It melts at a temperature of slightly over 500° F. One of the objections to bismuth though, is its cost, being over $2.00 per pound. Occasionally aluminum is mixed in bearing metals. It melts at 1,160° F., adds toughness and serves as a flux and at the same time increases friction. One therefore cannot recommend a very liberal usage of aluminum or copper.

One particularly noticeable feature in the mixing of metals is that after being once melted and mixed the melting point of the mixture decreases. That is, the melting point of the bearing metal will melt at a lower temperature than the melting point of the highest of the original metals. Sometimes the melting point of the mixed bearing metal drops below that of the melting point of the original whose melting point was the lowest.

Recent Patents

The following patents of interest to readers of this journal recently were issued from the United States Patent Office. Copies thereof may be obtained from R. E. Burnham, patent and trade-mark attorney, Continental Trust Building, Washington, D. C., at the rate of 20 cents each. State number of patent and name of inventor when ordering.

1,519,101. Excavating device. Edwin J. Armstrong, Erie, Pa., assignor to Erie Steam Shovel Co.

1,519,147. Mining and loading machine. Nils D. Levin, Columbus, Ohio, assignor to Jeffrey Mfg. Co.

1,519,241. Attrition mill. Allan P. Daniel, Springfield, Ohio, assignor to Bauer Bros. Co.

1,519,731. Mining apparatus. Morris P. Holmes, Claremont, N. H., assignor to Sullivan Machinery Co.

1,519,989. Pulverizing mill. Harry R. Collins, Allentown, Pa., assignor to Fuller-Lehigh Co.

1,519,990. Pulverizing mill. Charles H. Breerwood, Allentown, Pa., assignor to Fuller-Lehigh Co.

1,519,991. Pulverizing mill. Charles H. Breerwood, Allentown, Pa., assignor to Fuller-Lehigh Co.

1,519,992. Pulverizing mill. Charles H. Breerwood, Allentown, Pa., assignor to Fuller-Lehigh Co.

1,520,202. Crusher. David J. Nevill, Denver, Colo., assignor to Stearns-Roger Mfg. Co.

1,520,228. Pulverizing-machine. Ernst H. Elzemeyer and Paul S. Knittel, St. Louis, Mo.

1,520,247. Portable shoveling and loading machine. Richard S. Jacobsen, Chicago, Ill.

1,520,319. Crushing-mill. Emil Barthelmess, Dusseldorf-Oberkassel, Germany.

1,520,916. Sand cuttng and screening machine. John S. Townsend, Harvey, Ill., assignor to Whiting Corporation.

1,521,022. Safety appliance for mining-machines. Morris P. Holmes, Claremont, N. H., assignor to Sullivan Machinery Co.

1,521,023. Mining apparatus. Morris P. Holmes, Claremont, N. H., assignor to Sullivan Machinery Co.

1,521,053. Mining-machine. Leon E. Simmons, Claremont, N. H., assignor to Sullivan Machinery Co.

1,521,217. Grinding-mill. Johan S. Fasting, Valby, Denmark, assignor to F. L. Smidth & Co., New York, N. Y.

1,521,418. Ball-mill. John R. Ball, Durango, Colo.

1,521,788. Mining-machine. Ralph E. Noble, Chicago, Ill., assignor to Garner Electric Co.

1,521,795. Conical crushing-mill. Charles F. Smith and Harvey H. Rumpel, Milwaukee, Wis., assignors to Smith Engineering Works.

1.521,891. Grinding-mill. Henry F. Kleinfeldt, Newark, N. J.

1,522,078. Excavating-machine. Charles F. Rayborn, Moscow, Idaho.

1,522,768. Power-shovel. Le Roy P. & Bird C. Clutter, Uniontown, Pa.

1,522,808. Grinding or crushing mill. Walter J. Coles, Sheffield, England.

1,522,860. Teeth for excavating and dredging buckets. James H. Boots, Beaver Falls, Pa.

1,523,007. Sand-screen. Horatio S. Earle, Detroit, Mich.

1,523,070. Disk of plate for use in mills or machines for grinding or pulverizing ores and other materials. Ralph Hush, Johannesburg, South Africa.

McMyler Change Office

The McMyler-Interstate Company, Cleveland, Ohio, announce the removal of their Detroit office from 1701 Washington Boulevard Bldg. to 1156 Book Bldg. This change becomes effective February 1st, 1925.

Lenawee Sand and Gravel Company Producing at Tecumseh Michigan

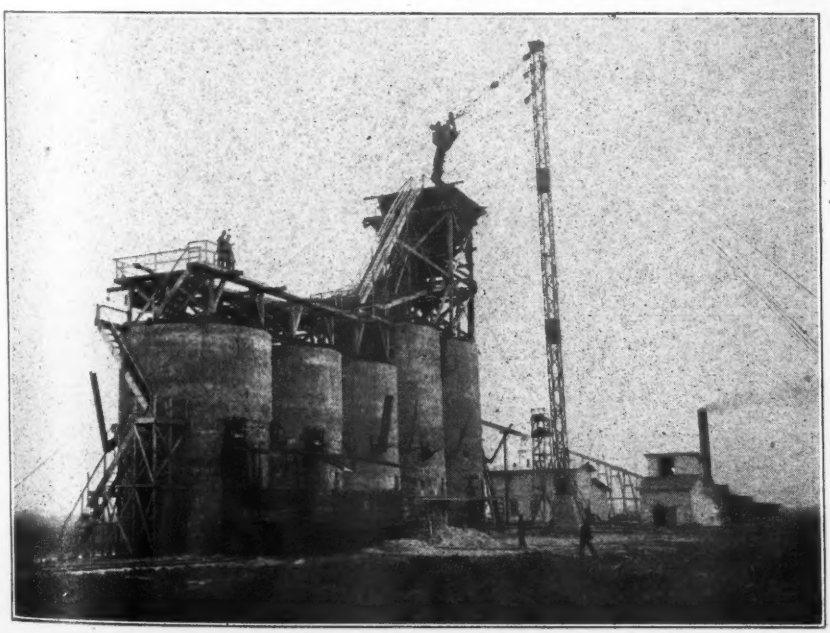
Plant of 1,500 Tons Daily Capacity With 47 Acre Deposit Trucks or Cars Loaded From Reinforced Concrete Bins

SOUTHERN Michigan and Northwestern Ohio will afford an active market for sand and gravel during 1925 to the Lenawee Sand and Gravel Company. The road program of Ohio, particularly, will call for great quantities of sand and gravel. Ohio will consume more sand and gravel in the 1925 program than ever before. The lack of funds will force this state to build gravel roads if they carry out their announced program.

The Lenawee Sand and Gravel Company of Tecumseh, Michigan, should enjoy a prosperous year. Their plant is located on the D. T. and I. and the New York Central Railroads with switching arrangements between the two roads.

A Link Belt slack line cableway excavator equipped with a 50 H. P. double drum Mundy hoisting and a 110 H. P. boiler brings the material to a hopper on top of the plant at an elevation of about 75 feet. The cableway is fitted with a 1½ yard bucket. The sand and gravel is fed from the hopper into Link Belt conical revolving screens. Three sizes of gravel and two sizes of sand are screened. Allen sand settling tanks are used in separating and washing the material. The material from the screens and sand settling tanks is dropped into five concrete bins. Three of these bins are thirty feet high and two are forty feet high. Each of the bins are twenty feet in diameter. The center bin has a mixed spout arrangement so that any mixture of three sizes of gravel can be loaded as desired. The material can be loaded from either side of the bins. Trucks are loaded on one side and railroad cars on the other.

The washing equipment including the screens and a Dayton-Dowd pump is driven by a 180 H. P. semi-diesel

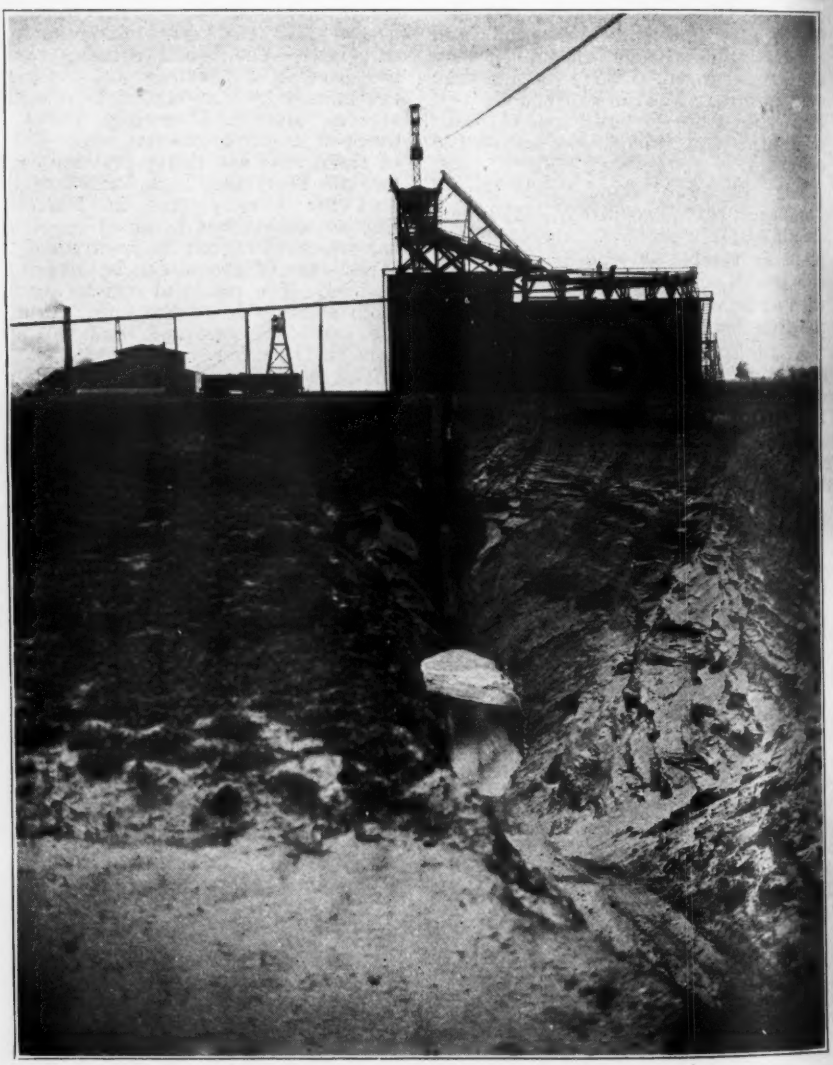


General Plant View.

Anderson oil engine. The water supply comes from a well 52 feet deep and 10½ feet in diameter. As the water was 35 feet below the surface of the ground, it was necessary to install a pump about 25 feet below the surface. The belt to the pump runs down an incline tunnel and is driven by an oil engine. Power is conveyed to the screening equipment by means of a rope belt. A stationary steam car puller is used for moving cars to and from the loading bins.

The present plant is located on a 47 acre deposit that runs over 90 feet deep. The Lenawe Sand and Gravel Company also owns about 40 acres of gravel land that is inaccessible from this plant.

The plant was designed and construction supervised by W. H. K. Bennett Company of Chicago. The officers of the Lenawee Sand and Gravel Company are S. J. Wilson, President; F. J. Blouch, Vice-president; Ira Washley, Secretary-treasurer; J. J. Bachmeyer, Dr. Nixon, A. A. Lehman and Elmer H. Thompson as Directors.

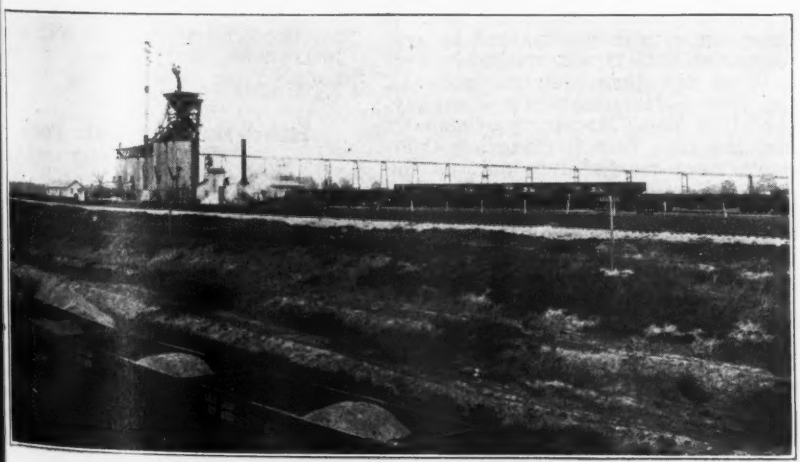


An Excellent View of the Deposit.

The Bellevue Sand & Gravel Co., of Clinton, Iowa, has been incorporated for $65,000, to produce and deal in sand, gravel, stone. rock, etc. The officers are: President and Treasurer, George H. Schneider; Vice President, George A. Schneider; Secretary, Frank W. Schneider.

The Ohio Portland Cement Co., Inc., of Cleveland, has been incorporated for $10,000, by McAlister Marshall.

The Oil Engine at Lenawee Company's Plant.



A General View of Plant and Property.

Link Belt Official Passes

On Christmas day, 1924, Mr. Glenn Grenville Howe, for many years Senior Vice President of the Link-Belt Company, passed away at his home in Muskegon, Mich., after a long illness.

His first connection with the Link-Belt organization was as a 16 year old office boy in 1877. Following his mechanical bent he drifted into the manufacturing department, and later became the Superintendent of the Ewart Manufacturing Company.

Mr. Glenn G. Howe

He knew the chain business thoroughly in practice and theory, and his conection with it was marked by sevconnection with it was marked by sev-

When the three related interests, the Ewart Manufacturing Company, the Link-Belt Machinery Company and the Link-Belt Engineering Company, were merged into one, as the Link-Belt Company, in 1906, Mr. Howe became Vice President, in charge of the Company's Indianapolis operations.

It was under his directions that the Belmont Malleable Iron Foundry, and Ewart assembly plant were built, in 1913; and he continued as Senior Vice President until failing health led to his retirement from active business.

Later, with returning health, he organized the Howe Chain Company, at Muskegon, Mich., serving as President of an organization which became a decided factor in chain making, through its thorough knowledge of th art.

About the end of 1923 Mr. How was stricken with the illness whic finally resulted in his death. The sa of the Howe Chain Company to th Link-Belt Company was made in Jan uary, 1924, and the Muskegon plan is now operated as the Howe Chai Plant of the Link-Belt Company specializing in chain manufacture along the lines so successfully estab lished under Mr. Howe's experience directions.

Mr. Howe was a wise counselor gifted with a deep fund of practica philosophy that appeared constantly in apt simile or pertinent aphorism He was very capable, and his opinion on manufacturing, accounting, an selling problems were always sound and his statement of them convincing

Miami Power Scrapers

A bulletin issued by The Miami Trailer-Scraper Co., Troy, Ohio, dis cusses Comparative Dirt Moving Costs between Miami One-Man Power Scrapers in connection with Fordson Tractors and Team-Wheeler Equip ment. Facts and figures give in de tail the cost of the tractor and the Miami One-Man Power Scraper; they then outline the cost of operation per day with teams on the average job and the cost of operation with the Miami, with this result:

The cost of moving with teams is 30½ cents per yard; cost with Miami Scraper, 15½ cents; the saving per yard, 15 cents. A broadside folder describes the work of the Miami on various dirt-moving jobs, with many illustrations, and a page of testi monials from owners of the machine

Road Building Data Book

A book entitled "Road Builder's Data Book," on Safeguarding the Con tinuous Supply of Concrete Aggre gates to a Paving Mixer, has just been issued by The Geo. Haiss Manufacturing Co., Inc., 141st Street and Rider Avenue, New York City.

The book discusses Advance Stor age of Aggregates vs. Daily Car of Truck Deliveries; Comparative Cost per Day of Loading Trucks; The Speed of Truck Loading vs. Batching Bins for Loading Trucks; and The Choice of a Loader for Advance Storage Stock-Piles. It is illustrated with diagrams.

Aggregates for Concrete

By C. D. FRANKS*

AGGREGATES comprise 80 to 85 per cent of the volume and about half the cost of materials in concrete. The aggregate is the most variable constituent so far as quality is concerned and consequently definite rules for its selection are of great importance. On account of the great weight and consequent expense of shipping long distances, it is essential that aggregates near at hand be used, if they are at all suitable. The preparation of proper specifications and methods of testing are greatly complicated by the almost endless variety of aggregate materials. The requirements to be met must be dictated to a certain degree by economic considerations and by local conditions.

Aggregate may be defined as follows: An insert material which is mixed with cement and water to produce concrete. In general aggregate consists of sand, pebbles, gravel, crushed stone, crushed blast furnace slag or similar materials. Aggregate for concrete must be clean, structurally sound and inert in the presence of cement and water. It must have that property which may be termed weather resistances. It must be able to resist frost action, the action of water, etc.

The separation of aggregate into fine and coarse is generally required, since it facilitates uniformity in the grading of successive batches of concrete. The Structural Materials Research Laboratory, which is maintained by the Portland Cement Association in cooperation with Lewis Institute, has devoted a considerable study to aggregates and their effect on properties of concrete.

One of the most important investigations consisted of concrete tests using about 150 different coarse aggregates collected from widely separated sections of the United States. These materials consisted of pebbles, crushed limestone, crushed granite, trap, sandstone, flint, marble, lava rock, tufa, fire brick, cement clinker, boiler cinders and miscellaneous materials. In order to secure a uniform grading they were screened into different sizes and recombined to a definite sieve analysis. They were tested with the same sand (a well graded concrete sand from Elgin, Illinois,) and with the same portland cement. The same volume of aggregate was used in each batch. The mix was about 1-4; one part of cement to 4 volumes of fine and coarse aggregate mixed as used. The consistency corresponded to about a 3 to 4 inch slump, about what would be required for hand finished concrete road construction.

Concrete specimens were made and tested both for compressive strength and for resistance to wear. The strength tests were made on 6 by 12 inch cylinders. The wear tests were made on 8 by 8 by 5 inch wear blocks in the Talbot-Jones Rattler. The wear test was made by placing blocks as the lining of a ball mill and subjecting it to action of a 200 pound charge of cast iron balls. So long as the coarse aggregates were structurally sound and reasonably hard, essentially the same results were obtained for both strength and resistance to abrasion in concrete whether they were pebbles, crushed limestone, crushed granite, sandstone, slag, flint, marble or what not. Strength tests were carried out at ages up to 1 year. The wear tests were made at 3 months. Of course soft friable aggregates, such as cinders and tufa gave lower results.

A similar investigation was made on about 250 different fine aggregates consisting of sands and stone screenings. Concrete specimens were made using a coarse aggregate, consisting of pebbles from Elgin, Illinois. Compression and wear tests were made. The different fine aggregates were mixed with the coarse aggregates to produce the same fineness modulus. Compression tests of mortar were also made in comparison with standard Ottawa sand. These tests showed the same thing as the tests of coarse aggregates,—that approximately the same results were obtained for similarly graded materials regardless of type, so long as they were free from harmful impurities. In interpreting these tests, however, some caution should be noted with respect to crushed stone screenings. Most

*Assistant General Manager, Portland Cement Association. Paper presented before National Crushed Stone Convention, January 12, 1925.

screenings contain excessive amounts of dust, and unless care is exercised, this will be washed to the surface and form laitance. If the dust is not present they are apt to be too coarse. The only safe way to avoid the harmful effects of the dust aside from washing it from the screenings before use is by the use of thoroughly mixed concrete of a consistency dry enough to prevent segregation and the collection of free water on the surface.

These results were not surprising to us in view of the fundamental principle of concrete mixtures which had previously been developed at the laboratory. The principle is that the strength of concrete is fixed by the ratio of volume of water to volume of cement, so long as the mixture is workable and the aggregates inert and made up of hard durable particles. Workability depends on grading of aggregate and consistency. The smaller the quantity of water with reference to the cement, the stronger the concrete.

Thousands of tests carried out on many different types of aggregates have demonstrated the accuracy of this principle within wide limits. The quality of the aggregates plays a relatively unimportant part in fixing the quality of concrete except insofar as they affect the water-cement ratio which must be used in order to produce a workable concrete.

In the main, the water-ratio of a concrete mixture is fixed by three factors:—

1. The plasticity or workability of the concrete required
2. The quantity of cement (the mix)
3. The grading of the aggregate.

It goes without saying that the more plastic or workable the concrete, the more water required, so long as other conditions are maintained constant. Increasing the richness of the mix decreases the quantity of mixing water in proportion to cement required for a given condition of workability. Coarse well-graded aggregates require less water than fine poorly graded aggregates. The sieve analysis is an accurate measure of the grading of the aggregate when properly interpreted. A function of the sieve analysis known as the fineness modulus has been found to measure accurately the value of the sieve analysis. This term may be readily calculated from the sieve analysis when the sieve analysis is expressed in terms of percentages, coarser than the following: Square mesh sieve No. 100, 48, 28, 14, 8, 4, ⅜, ¾, 1½, etc. The important characteristic of this set of sieves is that each sieve has a clear opening double that of the next smaller sieve. These sieves are practically the same as those recommended by the American Society for Testing Materials for sieve analysis of aggregate. The economic selection of an aggregate, therefore, consists in choosing materials of suitable cleanliness, hardness, and durability which will produce concrete of the required workability and strength with a minimum of cement. Since the water ratio fixes the strength, this resolves itself into choosing materials, which will produce the most concrete or a given amount of concrete at the least cost of material for a given water-ratio.

Tests carried out both in the laboratory and in the field have shown that the average strength of concrete when molded into 6 by 12 inch cylinders and tested under standard conditions may be represented by the following relation between strength and quantity of mixing water:

Compressive Strength at 28 days lb. per sq. in.	Limiting Quantities of Mixing Water Gallons per Sack of Cement.
2,000	7 to 7½
2,500	6¼ to 6¾
3,000	5½ to 6
3,500	6¾ to 5¼
4,000	4¼ to 4¾

Field tests carried out on 7 different construction projects in New York and vicinity by our laboratory in cooperation with the Associated General Contractors have shown that properly made tests of concrete placed under field conditions will give results of which 85 to 90 per cent are higher than 80 per cent of the value given by this relation.

The comparative flexibility which the application of this principle to the design of concrete mixtures lends to the selection of materials should be readily appreciated. When full advantage is taken of it, the specifications of concrete of different strength requirements become a simple matter. From the engineer's viewpoint only the water ratio, and quality of aggregates so far as hardness, durability, and impurities are concerned, time of mixing, curing conditions, etc., need

be specified, with the added provision that the concrete be workable and produce a suitable appearance. The matter of proportions, grading of aggregates, and plasticity of the concrete can be left almost entirely to the contractor or construction engineer, and these will be dictated by that most exacting of all task masters-cost.

I have attempted to hit only the high points of the fundamentals of good concrete, and the function that aggregates play in it. All of these points will bear considerable elaboration, but perhaps a still briefer summarization will make them stand out more clearly:

1. So long as concrete is workable and the aggregates are hard and durable and contain no harmful impurities, the water ratio fixes the potential strength of concrete. I use the word potential because, of course, after the concrete is proportioned and mixed its strength is vitally affected by manipulation, curing conditions, etc.

2. Differences in aggregates of good quality affect the strength of concrete only insofar as they influence the quantity of mixing water required to produce a plastic workable concrete.

3. While wet mixtures do not produce lower strengths than dry ones for the same water-ratio, they should be avoided because they are uneconomical, and because particularly in wearing surfaces, the fine materials and excess water are brought to the surface forming a weak friable mortar which does not properly withstand either weather or wear.

Machine Bores in Holes and Sets Poles in Solid Rock

BORING holes through solid rock is the latest development of the FWD Earth Boring Machine which heretofore was known only for "boring the holes and setting the poles in any kind of soil that can be dug by hand methods without blasting." The boring-through-rock experiment was made by the Union Gas and Electric Company of Cincinnati, Ohio, which company is erecting a high power transmission line over a stretch of particularly hilly and stony country.

In the work of digging the holes for the tower abutments many different sizes of augers are used. First, the 48 inch auger is used to bring the working level of each corner to the same plane. Because of the hilly nature of the country this work sometimes requires considerable digging with the big auger. Next, a 24 inch hole is dug about three feet deep at the bottom of the 48 inch hole. (This is later filled with concrete after the corner post has been set.) Below the 24 inch hole an 8 inch hole is dug 11 feet deep at an angle of 9 degrees from the perpendicular.

In digging the 8 inch hole a layer of rock varying in thickness of one foot to the depth of the hole is very frequently encountered. In these instances the first operation in boring the 8 inch hole is to bore a 1¾ inch hole through the rock the required depth. A 1¾ inch drill is attached to the auger shaft and the hole is drilled through the solid rock at the rate of almost a foot in ten minutes. In one instance where the rock extended the full length of the 11 foot hole, the hole was drilled in 2½ hours. (Such a hole drilled by hand methods would require 3 men 3 or 4 days.) After the 1¾ inch hole is dug it is shot with dynamite and then cleaned out with an 8 inch auger. The cleaning out process requires but a few minutes.

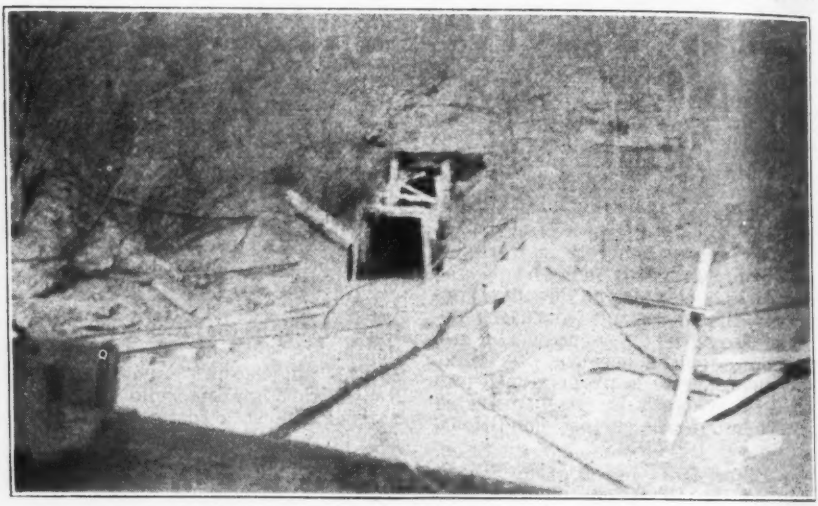
The holes for the corner posts are drilled at an angle of nine degrees from the perpendicular. It is necessary that the degree of the slant of the hole shall not vary from this specification more than one inch. In order to insure this exactness the boring machine is leveled by instruments and the "tower" which carries the auger shaft is tilted to the proper degree. At the dead end towers an additional hole is drilled for the braces. This hole is also drilled from the bottom of the 24 inch hole. However, at the dead end towers the main holes are dug 4 degrees from the perpendicular and the hole for the braces are dug at an angle of 31 degrees from the perpendicular.

Drilling through solid rock, although a new application of the boring machine, is evidently working out very well, for the Union Gas and Electric Company kept their FWD digger busy 24 hours a day, light for the night work being supplied by a portable power plant.

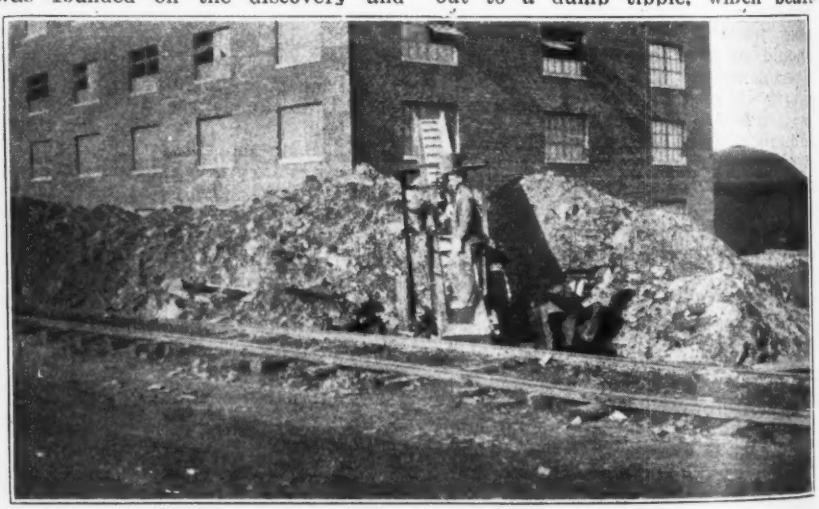
Shale Mining

ONE of the interesting shale mining operations of the country is that carried on in garnering raw material for sewer pipe by the Cannelton Sewer Pipe Co. This big industry which converts 200 tons of shale a day into sewer pipe on the banks of the Ohio River, was founded on the discovery and development of an interesting vein of soft broken shale which was found outcropping on some coal land property in one of the big hills overlooking the town of Cannelton. It is a combination of shale and mongrel fire clay ideally blended for making sewer pipe from the material as is.

The shale operations are carried on exactly as coal is mined, that is, by drifting in, blasting down, and loading on mule tram dump cars. The mine trucks carry a ton and a half out to a dump tipple, which bears close resemblance to a coal tipple, where it is weighed, then dumped into tram cars which convey it to the sewer pipe plant about a quarter of a mile away.



Shale Mine Opening Overlooking Cannelton, Indiana.



Shale Reserve Pile.

Speed Reducers

By B. E. SCHENKER

THIS is, essentially, an era of high speed prime movers. The turbine with its high r.p.m. is far more efficient than the low speed engine. The small high speed motor is more efficient, just as powerful and less costly than the larger one of slow speed.

Because industries are eager to adopt these more efficient units, the problem of speed reduction is more significant than it has ever been. The solution of this problem calls for a compact, efficient device that will permit the use of the high speed units with their economy, and step down and r.p.m. to a practical degree.

Pulleys and belts, chains and sprockets, rope drives, open gearing, or any combinations of those are all methods of speed reduction found in practically every industry. While these methods of supposed reduction possess certain individual merits, they also have serious objections. Since the maximum practical ratio for belt drive is 6:1 and that of chain or spur gear is 8:1, it is evident that great reduction is only possible by the use of a series of reducing units.

Satisfactory service on double belt transmission requires a minimum pulley diameter of 12 inch triple and quadruple belts requiring pulleys of larger diameter. It is evident, then, that transmission that requires considerable speed reduction would necessitate the use of much space.

Open gearing and chains traveling at high velocities and insufficiently lubricated, as they often are, wear rapidly. Belts and ropes deteriorate quickly, particularly in plants where there are fumes. Besides, there is the "danger" objection which is an important one, unless all exposed rapidly moving parts are well guarded.

In order to meet the demand for a speed reducer that will meet all general purposes, that will permit the use of the efficient high speed prime movers, and still not possess the disadvantages of the prevalent methods of speed reduction—a number of concerns have placed upon the market, a unit known generally as a Speed Reducers.

These reducers represent considerable progress in their field. They are all compact, safe, and possess none of the disadvantages outlined above. The design of gear reducers falls into four general classifications.

1—Worm
2—Plain Spur
3—Planetary
4—Non-Planetary

Worm gearing is a common method of securing high speed reductions between shafts which are at right angles to each other. Speed reducers of this type are produced by a number of concerns, and are all of similar design. Both the worm and gear are entirely encased and run in an oil bath. The worm is generally integral with the high speed shaft. The difference in elevation of the high speed shaft and the low speed gear shaft is the center to center distance between the worm and gear. Satisfactory transmission is best obtained when the gear is of bronze and the worm of a case hardened low carbon steel. The controlling factor governing load capacity of any worm gear transmission is the heating effect rather than the strength of the gear teeth. When overloaded the temperature often increases to such an extent that the oil becomes too thin to lubricate properly, resulting in excessive wear.

The worm type of reducer is a satisfactory unit within its capacity and should not be used to carry loads at speeds for which it is not designed.

The most used forms of speed reducers are those that reduce in a straight line, the low speed shaft being to all outward appearances a continuation of the high speed shaft. There are three types of design of this kind of reducers, plain spur, planetary and non-planetary. All these types are totally enclosed in a cast iron case consisting of a housing and two head plates. These vary in design, depending upon the particular construction of the unit.

The plain spur gear type of speed reducer consists of a series of spur gears, each revolving about its own center. The high speed pinion meshes usually with three idler gears making contact at 120 degrees points of the pinion. Integral with each of these gears, or better yet, keyed to the same shaft is another smaller gear which in turn drives a larger gear, making contact at 120 degree

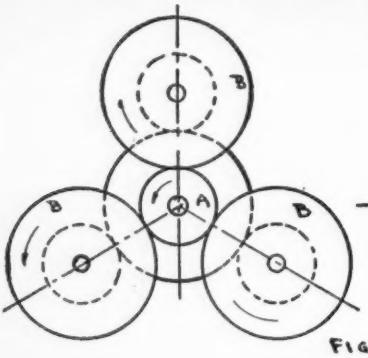
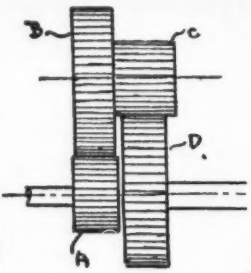


FIG. 1



points of the larger gear. This large gear is keyed to the slow speed shaft. Any reduction required may be attained by proper gear ratios, or by making series combinations of the unit just described. Figure 1 shows diagrammatically the relationship of gears of this type.

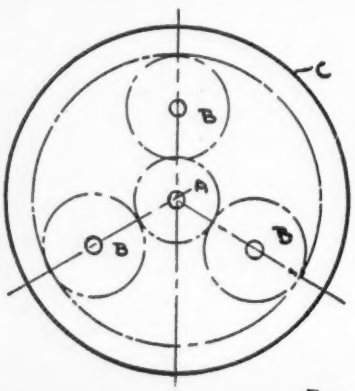
Pinion "A" is high speed, being keyed to a shaft which is coupled to the motor. It meshes with the three larger gears "B", bringing a reduction dependent upon the gear ratio. Gear "C" moving at this reduced speed further meshes at three contact points with D for further reduction. Essentially there are five units to this single stage reducer; the high speed shaft and pinion, three counter shafts each carrying a large and small gear and the slow speed gear with its shaft. A reducer of this type, although there are two reductions, is known as a single type. The double reducer has a larger case with a partition between two stages, similar to one just described. These stages are connected in series. In this type of reducer the principal loads are subjected to the counter shaft journals as a result of the tooth thrust on the gears "B" and "C".

The third class of speed reducers belong to the planetary type. Like reducers in class II, these also are straight line reducers, using not only plain spur gears but employing also an internal gear.

Figure 2 shows essentially the working mechanism of a single stage reducer of this type. Here, as before, the high speed pinion A meshes with the three intermediary gears "B." The gears "B" are journaled on stud-like shafts that protrude from a substantial plate "D" which is integral with, or keyed to, the low speed shaft. As the three intermediary gears "B" rotate about centers they mesh with a stationary internal gear "C". This causes the entire unit consisting of the three intermediary gears, the plant in which they are journaled, and the low speed shaft, to rotate. Greater speed reduction is obtained by making series combinations of this single stage.

The fourth general classification of gear reducer is generally known as the non-planetary type and possesses certain advantages. The general principle upon which it is based is shown in Figure 3.

Here as in the planetary type we find the small high speed pinion making three point contacts with three intermediary gears which, in turn, make three point contact with an internal gear. In the non-planetary type, however, the intermediary gears "B" are journaled in the frame and the internal gear "C" is free to move. For further reduction, series combinations of this unit are employed with substantial partitions between each member of the series in



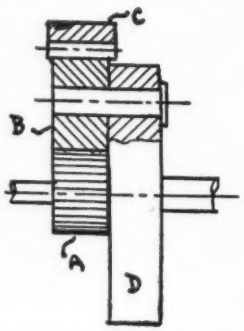


FIG. 2

which the intermediary gears are journaled.

An analysis of the three general types of straight line speed reducers indicates certain characteristics common to all types and certain particular properties that make each distinctive. The common characteristics possessed by all three classes of reducers are:

1—Straight line reduction

2—Two reductions in a single stage

3—The use of three intermediary gears driven by the high speed pinion.

Each particular type, however, is unique in itself. As seen in figures 1, 2, and 3, pinion "A" is subjected to the same forces in all the types, the forces being applied at 120 degree points. Assuming that the horsepower being transferred is the same, and the pinions of equal size, each pinion is subjected to three forces of equal magnitude.

The task of a speed reducer is to deliver high speed power to lower speed. Theoretically, there is no loss of horsepower in this transformation. Actually, there is very little. The formula for H. P. illustrates exactly what change is made in the reduction of speed.

$$(1)\quad H=\frac{P\pi\ D\ N}{33000x12}$$

Where H is horsepower; P is load in pounds; D is diameter in inches; N is revolutions per minute.

Torque is expressed by the formula

$$(2)\quad T=P\ \frac{D}{2}$$

Therefore, substituting equation 2 in equation 1

$$(3)\quad H=\frac{\pi T\ \ N}{33000x6}=\frac{T\ \ N}{63025}$$

or

$$(4)\quad T=\frac{63025\ N}{H}$$

$$(5)\quad H=\frac{T\ N}{63025}$$

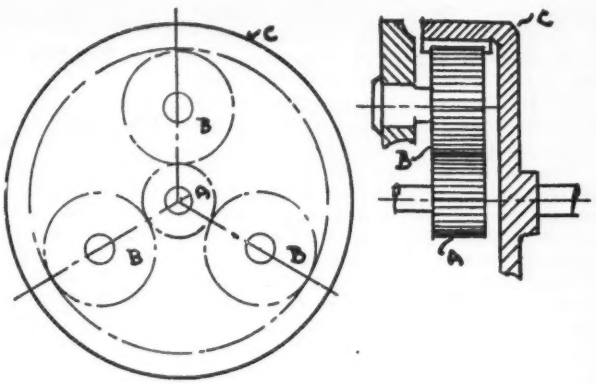


Fig 3.

$$(6)\quad H^2\ \frac{T_2\ N_2}{63025}$$

Where T, is torque at high speed, N is high speed r.p.m., T2 is low speed torque; H2 is low speed r.p.m., but

$$H=H_2$$

$$\frac{T\ N}{63025}\quad\frac{T\ N}{63025}$$

$$T\ N = T_2\ N^2$$

$$(7)\quad \frac{T}{T_2}=\frac{N_2}{N}$$

Equation 7 indicates that the torque and the r.p.m. are inversely proporational when frictional losses are disregarded.

Equation 5 indicates what occurs when the speed is reduced. H, the horsepower, is a constant. Diminishing the denominator N, therefore, means an increase in torque, T. If the low speed shaft rotates at 1/100 the high speed shaft the torque is increased 100 times by the speed reduction.

Referring, again to equation 2, we find that T is a function of the load and diameter. If the load be applied at a short radius to give a certain torque, it must of necessity be larger than if applied to a greater radius. So great does this torque become upon great speed reduction that the three point application of load, found in all the types of reducers, is necessary to keep down the tremendous size of a single load.

The non-planetary type goes a step further in this respect by making the torque radius as large as possible. The final reduction is accomplished by the intermediary gears driving the in-

ternal gear. Since the load is applied in three points on the internal gear such force is one third component of the entire and the entire is the least possible because it is applied at the greatest possible radius, at the pitch circle of the internal gear.

The planetary type does not fully utilize this advantage as the true final propelling is accomplished by the reaction in the journals of the intermediary gears that force the rotation of the plate "D" (Figure 2). The force arms in the plain spur gear type of reducer are the pitch radius of the gear "D" (See Figure 1) which is less than the arm of either of the other two types.

To determine which type of design of speed reducer is the superior, it is logical to list the requirements of speed reducers in general, and the type that best fulfills these requirements is perhaps the best in design. Speed reducers claim their place as a superior form of transmission on the following basis.

1—Great reduction of speed possible
2—Compactness, small space required
3—Safe—no open gearing
4—Dirt and dust proof—entirely enclosed

The non-planetary type possesses a number of elements that mark it as perhaps the best type of straight line drive speed reducers. It is the simplest, requiring the fewest working parts—employing only the high speed pinion, three intermediary gears and an internal gear. There is no revolving of the entire mechanism as in the planetary type. The intermediary gears turn only about their centers and drive the internal gear which is keyed to the low speed shaft. The intermediary gears are journaled in the frame. The greatest force is developed at the final reduction, when the torque is greatest, which is at the three points where the intermediary gears drive the internal gear. The lever arm is then the greatest, the pitch radius of the internal gear, which make the load on the gear teeth as small as possible.

The non-planetary type more fully meets the requirements of the ideal in speed reducers than any of the other types. Besides possessing the necessary qualifications it exceeds the other types in compactness and design.

New Style Metal Chutes and Liners for Gravel and Quarry Plants

BAKSTAD Machinery Company, 122 S. Michigan Avenue, Chicago, announces that in addition to their regular line of complete equipment for gravel and quarry plants they have recently secured for representation the "STRENES" Metal Chutes and Liners, manufactured exclusively by Advance Foundry Company of Dayton, Ohio.

"STRENES" Metal was developed for use in places where parts are subject to severe wear and abrasion and is not only hard and tough, but is also long grained of a structure such that the grain runs through the sections, whereby the wear is taken on the end of the grain.

While "STRENES" Metal is used extensively in many varied fields, its application in the industries using chutes for distributing abrasive materials, is of special interest to our readers.

"STRENES" Metal Chutes were designed to effect savings in the cost of installing, maintaining and repairing chutes and are furnished in half-round and oval sections from 10 to 24 inches in width by 24 inches long.

These sections are cast with lugs for attaching to wood stringers, lap joint assures perfect alignment and water joint for washing operations. Thus it is not required to build boxes or flumes to be lined with sheet steel and new sections can be replaced in a few minutes.

Flat or special liners are also furnished where wooden chutes may not readily be replaced or to meet any condition peculiar to individual installations.

A new bulletin "STRENES Metal and Its Uses" showing also diagram and dimensions of standard chutes has been published and will be mailed upon request by Bakstad Machinery Company, 122 S. Michigan Avenue, Chicago.

Mr. W. H. Agens, formerly district manager of the Traylor Engineering & Mfg. Co.'s Seattle office, has been appointed district manager of the Southwestern territory for the same company, with headquarters at the I. W. Hellman Bldg., Los Angeles, Calif.

Industrial Transportation

Written Expressly for PIT AND QUARRY by R. N. VAN WINKLE.

TRANSPORTATION is truly, as someone said, the backbone of industry and this is true regardless of whether the industry be a soap manufacturer, a glass factory, an automobile plant or a stone quarry. Industrial development and expansion are directly dependable on adequate transportation, while inadequate transportation means strangulation of any industry no matter how big or healthy, so without proper and easy means of transportation it is obvious that the highest development of any industry or territory cannot possibly be attained.

Transportation, or haulage, as we have come to term it, is one of the fundamentals of the successful operations of mines, pits and quarries and if one was to undertake a study or investigation with the idea of improving transportation or haulage, he could do no better the writer believes than to learn from the experience of his neighbor, the steam trunk line railroads. In the making of improvements or betterments it is not criticism we want especially, but models, models worthy of imitation and our steam railroads as a whole are models from which we can derive much benefit on this subject of the problems of transportation. Our steam railroad transportation system has been developed by systematic methods, by the ingenuity of the engineer and the boldness of conception and the wisdom of some of our greatest empire builders, while in a great many instances the transportation and haulage of mines, pits and quarries are to my mind a good deal like Topsy—just grew. The average transportation or haulage system, if system we can term it, of our mines, pits and quarries has not been the result of a well thought out scheme or plan for economic hauling and future expansion as has been the policy and practice of our neighbors the steam railroads, but it has been sort of a mushroom growth to meet the immediate demands imposed upon it.

As we have come to know it, transportation or haulage means tracks, motive power, cars and all equipment and facilities necessary to the furnishing of adequate transportation. The problems which confront the operator of industrial transportation or haulage systems are identical in many instances to the problems encountered by our big neighbors, the steam railway lines, and as proof of this statement the writer has selected six problems we might call them, which should and do have a direct bearing on the betterment of transportation as a whole.

1. Decrease of physical resistance to be overcome so as to lessen the tractive power necessary to haul a ton of freight.
2. The improvement and design of water and fuel locations.
3. The most economic motive power, steam, electricity or gasoline.
4. Design of cars and locomotives so as to get the maximum of capacity and strength with the minimum of dead weight.
5. Location, design and equipment of repair plants for locomotives and cars.
6. Elimination of waste which is present in all walks of American life.

Physical resistance might be termed friction resistance and can be decreased by good track, easy curves, low grades, suitable cars, and while mechanical condition, lubrication and temperature are in reality physical resistances it is not necessary to try to cover them in this article. It will doubtless be of interest to most of us to know what these resistances mean in actual figures. The frictional resistance or rolling resistance for instance of the average quarry car, which as a rule is hard running, varies from 10 to 25 pounds per ton, but this resistance increases rapidly under load, car and track conditions, running as high as 20 to 40 pounds and even higher in extreme cases. Resistance due to curves is 8/10 pound per ton for each degree of curvature, while resistance due to grades is 20 pounds per ton for each one per cent of grade. It is quite evident then that bad track, sharp curves, heavy grades and poor rolling stock are the big factors in cutting down the efficiency of motive power and are the very reasons why steam line railroads have, and still are spending millions of dollars in the relocating of main tracks to eliminate curves and grades as far as possible. Good track

is a fine investment and real insurance against wrecks, costly delays and big repair bills for maintenance of rolling stock. Good track is a necessity to adequate transportation and cannot be made out of odds and ends like hash of a crazy quilt, but standard material and good workmanship are basic essentials. The rail used in any track structure is highly important and the weight of rail needed expressed in pounds per yard should be approximately three times that expressing the weight of a two axle locomotive in tons which is to operate over the track. It must be understood that the selection of rail is influenced also by other factors, such as character of the road bed, ballast, tie spacing, etc., but it is hopeless to even attempt to make good track out of poor rail.

The question of design and location of water and fuel locations might appear off hand, negligible to many of us, but great waste and much valuable time is consumed in watering and fueling locomotives. Locomotives are made and purchased to haul tonnage and when they are standing still waiting for water or fuel they are an expense and are not performing the service for which they were intended. A very highly efficient watering and fueling layout for the average industrial haulage outfit can be built up at a small expense and is a means of stopping one of the many costly small leaks for which we should be constantly on the lookout.

There seems to be many different views regarding the third item, but unquestionably all three, steam, electricity and gasoline as motive power have their advantages and doubtless some disadvantages. It is an easy matter to make a selection after weighing the conditions, quality of water, cost of coal, gasoline, or kerosene and the availability of electric current together with the cost of same. It is almost a mathematical problem. It is fair to assume, however, that with the further improvements of Ethyl Gasoline and properly designed gasoline engines that we may look for cheaper and more efficient motive power from gasoline. All the three forms of motive power are acceptable and good practice, being in successful use today, so a choice depends on cost and adaptability to the case in hand, still a capital investment in changing over an existing and obsolete layout to something cheaper and more efficient is certainly worthy of consideration.

To the writer's mind, the design of cars and locomotives so as to get as near the maximum of capacity and strength with the minimum of dead weight is worthy of the deepest thought and fair minded consideration. Personally he feels we have already gone to the extreme, being truly American, in building and using cars and locomotives that are too heavy for economy when everything is considered. There are certain limitations placed by track structure which we cannot disregard and it appears to me that in many instances we have about reached the limit of concentrated loads. There certainly is an economic limit as to the weight of a locomotive required to perform certain work and when considering the weight of locomotive needed one must first figure the hauling capacity required which involves train resistance, also grade and curve resistance of both train and locomotive. Locomotive resistance including machine and rolling friction can be figured at about 25 pounds per ton of weight on drivers and the same for all speeds. Leading, training and tender trucks resistance is approximately the same per ton as the cars of the train. The tractive power and weights of different classes and types of locomotives are easily obtainable from tables in locomotive catalogues. Then to find the hauling capacity on level track we deduct the total engine and tender resistance (in pounds) due to machine and rolling friction from the tractive power and divide by the train resistance in pounds per ton. The result is the hauling capacity of the locomotive in tons. In the case of grades or curves the resistance of the locomotive due to grades and curves must be added to the resistance of the locomotive on the level, then deducted from the tractive power and divided by the train resistance per ton on the level plus the resistance per ton due to grades and curves. The result is the number of tons a locomotive will haul up grade. It is a splendid idea to select a locomotive that will give you ample reserve power in emergency cases and if one will be guided by the recommendations of reliable, established locomotive manufacturers in the selection of suitable motive power, little if any disagreeable experiences will arise. Too often second hand locomotives entirely unfitted

for the operations in hand are purchased in an endeavor to conserve on expenditures with disastrous after results.

The car question is a big one and an operator sees and is offered so many different shapes, styles and capacities that he sometimes becomes dizzy, still with cars it is a good deal like the Irishman with the whiskey, they all look good only some are better than others. Our problem is to find the best car for our particular conditions. As far as open pit operations are concerned there is a great need for the standardization of cars which would ultimately mean that the manufacturer could stock a few standardized cars of different gauges and capacities assuring the user prompt delivery of both cars and repair parts and through this means of such standardization the cost could probably be somewhat reduced. A car to my notion has quite a few human characteristics, its economical operation is directly affected by sudden changes of temperature, to be efficient it must be kept in condition and it is moreover subject to strains and fatigue and will break completely down if continually overloaded. Variance of conditions in layout and operations require different styles of cars, but small car units appeal to the writer from the standpoint of first cost, light maintenance, easily handled when derailed or wrecked, easy and quickly transported from one location to another, will in an emergency operate over track not fit for heavy equipment and due also to the fact you can have more of them assuring, providing all other units of the transportation or haulage system function properly, a constant supply of raw material and a constant supply of empty cars at your loading point. Where 36" gauge track is used small units, small cars, small trains and light locomotives have an advantage over larger units due to the fact of their flexibility in dispatching to the point needed, their ability to operate quickly over good track and if one unit does meet with grief such as a derailment, only a small per cent of your transportation system is unavailable instead of a major portion of it as would be the case with big unit equipment. Naturally there are exceptions to every rule and where an operation permits of permanent tracks and is of magnitude enough to warrant standard gauge equipment, large units of transportation are doubtless the best up to a point of where they become unwieldy. The prerequisite of a good car is its truck or running gear and the ability of this truck to stick to the rail, or in other words its freedom from derailment. When a truck or running gear with these qualifications is found it then becomes rather a simple matter to design or build a body to fit the truck and meet the requirements of dumping angle, discharge opening, etc., to suit the specific conditions. It it almost impossible to build a car body to successfully withstand the continuous rough usage imposed upon them by loading with a steam shovel, especially rock, but if the body is put on the proper truck a great saving will result due to the fact that the cars will stay on the track, thus avoiding the heavy expenses involved by derailments and wrecks. Steel and steel castings are preferable for truck running gear construction, inside, instead of outside journal boxes, roller bearings, leaf or spiral springs, iron or steel wheels, draft rigging, couplers and brakes are some of the high spots in selecting suitable trucks.

While steel is oftimes used in the making of car bodies or beds, wood properly and amply reinforced with steel plates, angles, steel rails, and truss rods, permit of greater flexibility not only in construction, but in withstanding severe shocks, as wood is easier replaced when worn out or broken. A car body made of steel and made heavy and rigid enough to successfully withstand steam shovel loading is generally too heavy for economical operation, while wooden construction can be made much lighter and wood further acts as sort of a cushion in withstanding hard knocks. In considering car bodies or beds, weight and durability are not the only things, but accessibility of dumping and righting, dumping angle so that the car will clean itself, capacity, discharge or door opening should be given thought. The life of any car depends on care given it and many cars have seen continuous use for nearly 10 years, and by careful attention to keeping tight bolts and nuts and replacing occasional broken timbers, are still in active service. Cars of any kind or any type need constant attention, a loose nut or a bolt may result in time in costly repairs or wrecks and replacement of wheels, and axles when needed assure

prolonged life of the car and reduced repair bills.

This brings us to the question of location, design and equipment of repair plants for locomotive and cars. Every one of us in riding through the country has been attracted by the well located, imposing looking railroad shops maintained by the steam railroad lines and if it has not been your good fortune to have visited one of these highly modern repair plants you surely have a treat in store for you. Our neighbors, the trunk line railroads have come to realize that adequate and safe transportation cannot be furnished with inefficient, dilapidated equipment and that minor and major repairs to rolling stock are absolute essentials. To the writer's mind a well built efficient locomotive or car is maybe, not strictly a thing of beauty, but I'll say a thing to be admired and when one stops to think of the original investment and the facilities provided, or lack of facilities provided, by some companies using industrial haulage, for the up keep of such equipment in which thousands of dollars are invested it is heart rendering. To my way of thinking it is just as big a crime to abuse machinery as it is to abuse a dumb animal. A rip track, a small drop pit and a blacksmith shop equipped with a forge, power drill press, small lathe, pipe and bolt threading machine, air compressor, air tools and actylene outfit is all the repair equipment necessary to maintain and maintain properly the rolling stock of the average industrial haulage outfit. There are very few mines, pits or quarries, or even contractors who cannot locate properly and equip adequately at a small expense a shop to properly make running repairs of their haulage equipment, provided proper thought is given to the subject. Naturally the bigger the operation the more elaborate the repair facilities may be, but having a small operation is no excuse for letting equipment go to rack and ruin. It is said you can tell a good mechanic by the way he takes care of his tools and I believe that you can tell a good operator and whether or not he is prosperous by the way he keeps up his equipment. If there is any truth in the old adage that "A Stitch in Time Saves Nine", it surely is applicable to the maintenance of machinery of every description.

We Americans are quite prone to boast of the bigness and superiority of things American. We take pride in telling of the biggest production and we are not afraid of comparisons as to quality of our output and gigantic achievements undertaken successfully, but while we doubtless have the right to boast, in one sense of the word of our superiority and achievements, they are accomplished at an astounding waste, waste of material, waste of money, waste of life and limb and wasteful practices of every description. Waste in American industry has been estimated as being as high as 40 per cent. Think of it, 40 per cent of our industrial activities resulting in waste and we can only hope to become more frugal in the use of our unlimited resources through strict application to the question in hand and through the leadership of trained minds which can prevent waste, standardize the process, enrich the thoughts and refine the spirits of the people.

In the forepart of this article the writer made reference to making a capital investment for the purpose of changing over an existing and obsolete layout and before closing this article it is worthy of being called again to your attention. According to efficiency experts there are many ways of increasing profits, such as greater output, higher sales prices, reduced operating costs, etc., but it is not always practicable to increase output or to raise the price, but it is possible to reduce in many, many instances operating costs by using the right kind of equipment and layout that will minimize waste, loss of time and unnecessary labor. It is true such equipment or layout may involve a little larger outlay, which I have previously termed capital investment, at the start, but the final results, the thing we are all after will show fine returns upon the investment.

Improvements in transportation practices have been steady and continuous over a long period of years and the total accomplished is more than likely to be lost sight of, still we all realize that not so many years ago all land transportation was furnished by packing on the backs of animals, which cost was approximately $3 per ton mile, while steam line railroads now based on 1921 figures haul a ton of freight a mile at an average cost to the public of about $0.0175. It is such things as this that we can learn many lessons.

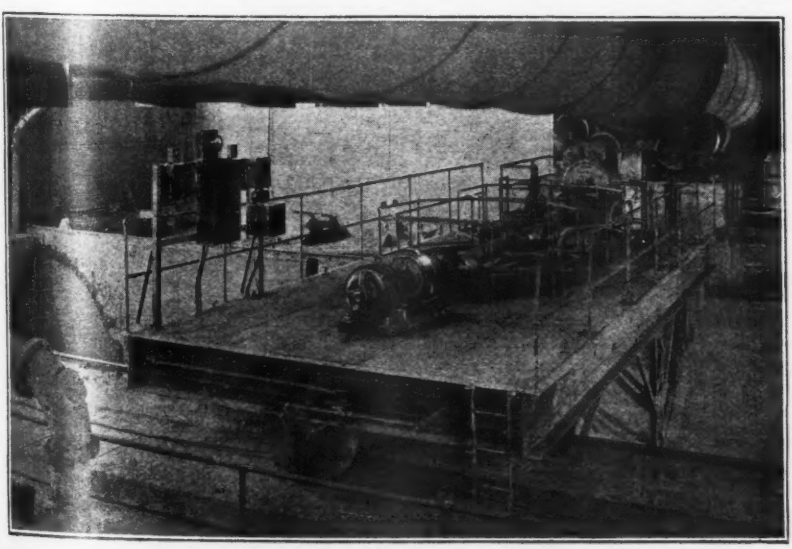
Glenn Falls Portland Cement Company Installs Unique Equipment

THE Glenn Falls Portland Cement Company, of Glenn Falls, New York, has recently changed its equipment from the dry to the wet process of cement manufacture. manufacture. Among the necessary changes was the addition of slurry mixing, correction and storage tanks and agitating equipment.

The new slurry tank used for the storage of the slurry after it is received from the correction tanks is of unusual size and capacity. An ingenious and unique method for agitation is employed; this has aroused much interest among executives and engineers of the cement manufacturing industry. This slurry storage tank is 125 feet long and 25 feet wide with a depth of 21 feet. It has a capacity of 7,350 barrels of cement which is sufficient for supplying material for nearly two days run of all kilns. This reserve supply of slurry provides an additional safeguard against possible failures in the supply of raw material or machine equipment of the preceding manufacturing operations.

While the size and capacity of the tank are unusual, the chief interest from the standpoint of the engineer is the method employed for agitation of the slurry to insure a uniform mixture at all times. The length and size of the tank make it impractical to use the standard form of stationary paddle mixers, but the desired result is accomplished by the use of a traveling agitator with rotating paddles as shown in the two accompanying illustrations. The agitator consists of a platform built on a structural steel frame and equipped with wheels which run on tracks on the edges of the pit.

The power equipment, for operating the agitating paddles and for the transverse movement of the carriage itself, is of compact design and installed on the movable platform which travels slowly from one end of the pit to the other and then automatically reverses. The electric power cable winds and unwinds automatically in the progress of the carriage forward and backward, and the air hose coupling winds and unwinds on the opposite side. It takes seven minutes for the platform, which is jokingly called the Tunneville Trolley by employees, to move from one end of the pit to the other, fifteen minutes for the round trip, giving a linear velocity of only 935 feet per hour. The power for running the agitation arms is sup-



Interior View Showing Speed Reducer.

plied by a 10 H.P. 570 r.p.m. General Electric motor, operating through a Foote IXL Worm Gear Speed Reducer.

This is the first installation of its kind used in an American cement mill and for this reason has attracted considerable interest. It also serves to demonstrate graphically the compactness, safety and efficiency of enclosed speed reducing units for this kind of work. Obviously to secure the great speed reduction necessary for the paddle and carriage drive by ordinary transmission methods, many belts, pulleys, chains and open gears would be required. This would be dangerous, would use up much valuable space and would be subject to rapid deterioration from the dust, dirt and grit that would inevitably accumulate.

Foote Coast Distribution

Foote Bros. Gear & Machine Co. have recently completed arrangements with F. Somers Peterson Co. of San Francisco for distribution of IXL Gear Products and Speed Reducers in northern California and with the Thomas Machinery Co. of Los Angeles for the southern section. The Pacific Coast distributing organization now covers offices at Los Angeles, San Francisco, Seattle, Portland and Vancouver, B. C.

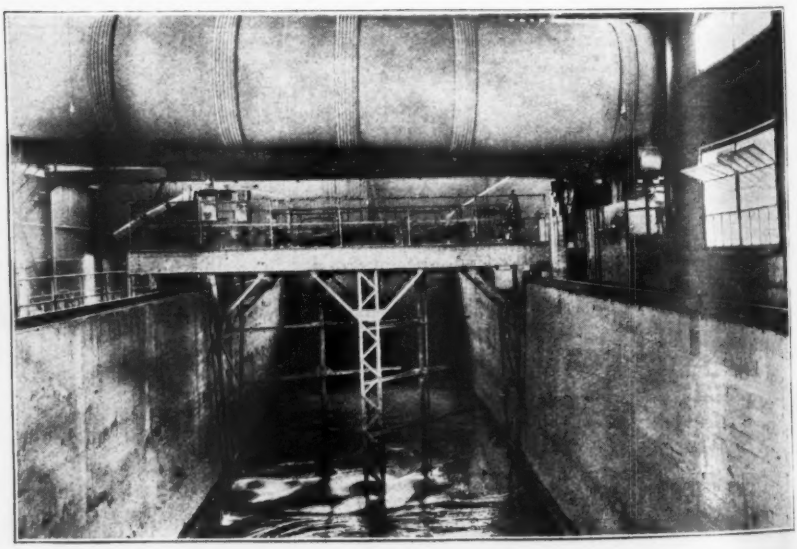
Contracting With Barber-Greenes

Contractng With Barber-Greenes is the title of an illustrated hand or pocket book just issued by The Barber-Greene Company of 645 West Park Avenue, Aurora, Illinois.

In this book for Contractors, pictures and information on typical jobs are given, in order to show the flexibility, economy and adaptability of Barber-Greene equipment to the contractor's every day problems.

Types of work shown, on which Barber-Greene equipment is used, are Sub-Grade Excavating; Close to the Mixer; Loading Wheelbarrows; Stock Piling at Intersections; Load for Trade and Road Job; Loading Industrial Cars; Unloading and Batching; Bucket Loader Converted to Snow Loader in Winter; In Place of a Tower System; Material Handling Delays and Their Solution; Handling Bag or Bulk Cement; Conveyors Pour Wet Concrete; Highway Departments Favor Type U; Keeping A Bin Loaded, and Pit Work With Loaders and Conveyors. Copy sent on request.

Mr. Geo. W. Walters has been appointed District Manager of the Northwestern territory for the Traylor Engineering & Mfg. Company—district office at 815 Alaska Bldg., Seattle, Wash.



Interior View Showing Slurry Storage Tank.

Slowing Up of Shipments

Most of the Cement Mills Are Maintaining Full Time Operation Schedules. Labor Satisfactory and Cars Plentiful

By Our Special Correspondent

THE TURN of the New Year shows an encouraging situation in the Lehigh Valley cement district in Pennsylvania, the majority of the mills maintaining active production. Sizable shipments for current account are leaving the plants, and incoming orders give prospects of full continuance on a capacity basis for months to come. The year 1925 bids fair to be a record-breaker for production and shipments.

The season for repairs and betterments, with machinery replacements, is here, and several of the mills have curtailed for a time to carry out essential work of this character. The slight lull in manufacture is only temporary, for practically every plant has a capacity schedule ahead to fill its bookings. The machine shops are busy with parts production and general equipment repairs; transmission apparatus and other operating equipment will be installed in connection with other plant improvements in a number of cases.

Despite the interruption for these mechanical betterment programs, production is being continued at full capacity at some of the largest mills. Some of the plants have been able to give attention to their stockhouses in recent weeks, and the situation in reserves shows considerale improvement. Withdrawals, however, are likely to be very heavy in the early weeks to come, and there is certainly no large surplus of stocks to tide over an extended demand period.

The winter season is causing a reduction in shipments. The average, however, is decidedly good for this period of the year, and the railroads are furnishing the desired quota of cars for this work. Motor trucks have had more difficulty in deliveries owing to the snow-bound roads.

Every mill, with but few exceptions, is holding to its full time operating schedule, and there is nothing in the general business situation to bring about any marked change. Bagging departments are holding to a heavy operating schedule, some mills working an overtime force in this branch. The labor supply is sufficient for all immediate demand, and there has been more opportunity recently to select the best help. Wage schedules continue without change.

The Alpha Portland Cement Co., continues active with a large force at its large mills at Martin's Creek, Pa., and vicinity, with bookings ahead to insure the maintainng of the present production schedule for weeks to come. The company is said to be planning to abandon operations entirely at its mills at Alpha, N. J., about 2 miles from Phillipsburg, at one time considered among the finest plants in the country; it is purposed to scrap a large part of the machinery, utilizing desirable equipment at other mills, and to raze the existing buildings. Operations will be concentrated at the Martin's Creek plant, and any necessary future expansion arranged for in this latter district.

The Atlas Portland Cement Co., Northampton, is running under full capacity at its local plant, with no early curtailment in sight. Sizable shipments have been leaving the plant, and current bookings are said to be good. The Lehigh Portland Cement Co., is operating at a good schedule at its different mills, including Mill No. 3 at Ormrod, and plants at Fogelsville and West Coplay. Current output is allowing a fair amount of stock for reserves, with good shipments moving to eastern and other points. There is no indication of any immediate slack at these mills. The Bath Portland Cement Co., is running at its Bath mill, as is the Penn-Allen Cement Co., at Nazareth; the Pennsylvania Cement Co. at Bath; the Hercules Cement Co., at Hercules; and the Phoenix Portland Cement Co., at Nazareth. Winter weather has slowed down operations at the different lime-stone quarries, but in the majority of cases, these plants are on the production list.

The Allentown Portland Cement Co., Allentown, is busy at its local mill, with employment of full working force, and expects to continue on the present basis for some time to come. E. J. Davis, superintendent at the plant, was the recipient of a handsome gold watch and chain at Christmas, given by employes at the mill; a Masonic charm and Shrine emblem is attached to the chain.

John B. Lober, president of the Vulcanite Portland Cement Co., with mill at Alpha, Pa., died on December 21 at his home at Wynnewood, Pa., aged 76 years. He has been prominent in the cement industry for a num-

ber of years and was one of the organizers of the Portland Cement Association. He was a member of the Union League Club, Philadelphia, and other organizations. Mr. Lober is survived by his wife and one son.

The Southland Portland Cement Co., Volunteer Building, Chattannoga, Tenn., has acquired a tract of about 9,000 acres of land in Cumberland County, near Crab Orchard, Tenn., as a site for a new mill. The initial unit will consist of several buildings, with power house, machine shop and auxiliary structures; the ultimate plant will comprise three kilns, and will cost a total of close to $1,200,000. It is purposed to begin work on the last two units immediately following the completion of the first structures. The complete works have been designed for a capacity of 3,000 barrels of material per day. Plans for the organization of the company and the construction of the plant have been in progress for a number of months past. James O. Parker is president; L. H. Wright, Indianapolis, Ind., vice-president; Oscar Mather, connected with the Volunteer Life Insurance Co., is treasurer; and Ben L. Ireland, temporary secretary.

The Peerless Portland Cement Co., First National Bank Building, Detroit, Mich., is pushing to completion the erection of its new mill on the River Rouge, in the Detroit city limits, now about 75 per cent finished, and expects to have the plant ready for service in the near future. The plant is designed to use waste heat from the kilns for power production, and is anticipated to show exceptional efficiency and economy in different departments of operation. Caustic waste, to be secured from a neighboring plant of the Solvay Process Co., will be used in part as a limestone substitute, with substantial saving in cost. The company has contracted for its limestone supply with the Michigan Limestone & Chemical Co., the agreement calling for the material to be delivered crushed, on the local docks. The new plant will have a rating of 1,500,000 barrels of cement per annum. The company is now operating a mill at Union City, Mich., and it is understood that this plant will be continued in active service. The company is disposing of a bond issue of $1,750,000, a portion of the proceeds to be used in connection with the new River Rouge mill, and for general financing. Colonel William M. Hatch is president.

The Missouri Portland Cement Co., Post Dispatch Building, St. Louis, Mo., has arranged for an increase in capital to $9,000,000, a portion of the fund to be used for general expansion. The company also operates at Memphis, Tenn., with a branch at Kansas City, Mo.

Much Road Work Done by Forest Service

More than 1,800 miles of roads and nearly 5,000 miles of trails were constructed within or adjacent to the 147 national forests during the fiscal year ending June 30, 1924, according to the annual report made by the Chief of the Forest Service to the Secretary of Agriculture. In addition maintenance work was performed on 7,423 miles of roads and 32,105 miles of trails.

Including the construction work completed within the last year, the total mileage of national forest roads constructed by June 30 of this year stood at 8,707 and the total mileage of trails at 15,855.

The sum of $9,351,142 was expended on the road and trail work of the Forest Service during the last fiscal year, the report says. This sum was augmented by funds from co-operative agencies, such as States, counties, and local organizations.

S-A Worm and Gear Speed Reducers

INNUMERABLE are the places where Stephens Adamson reducers may be installed. The wide range in sizes and in reduction ratios make installation particularly popular where electric motors are to be connected to mechanism which operate at comparatively slow speeds. The engineers of the Stephens Adamson Manufacturing Company have carefully designed the different parts of these reducer units giving particular attention to the cutting of the worm and worm gear and also to the thrust bearing and stuffing box.

S-A worm gear reducers are standard in twelve different sizes which may be equipped for the required ratio. The different ratios are securd with the furnishing of the ring gear with the proper number of teeth to give the desired reduction.

State Highway Specifications

State Commissions to Re-write Specifications for Materials. Fewer Cars Expected Available; Sand-Gravel Active.

By Our Washington Correspondent

FOLLOWING suggestions made at the recent conference in Chicago, Secretary Barrows of the National Sand and Gravel Association is already taking steps to inform users of sand and gravel products of the high-grade nature of materials produced by members of the association. In fact, this is merely a continuation on a more extended scale of the work the association has been doing for years.

Soon after Secretary Barrows returned to Washington he found a communication from the Kentucky Highway Commission informing him that the commission intended to re-write its specifications for materials for highway building and requesting Secretary Barrows to forward a list of specifications for high-grade materials that could be furnished by members of the association. The commission also requested Secretary Barrows, or a representative of the association, to appear before the commission at a dat to be named later and justify the specifications submitted. The commission stated that it is seeking the advice of the association on specifications for materials to be used in highway building.

Secretary Barrows accepts this as the first step toward what other state highway commissions may be expected to do along this line. He believes that it is only a question of time before State highway commissions generally will call upon the association for specifications for materials and that they will see the wisdom of purchasing materials from members of the association so as to be assured of only the high-grade products that can meet the specifications required.

In connection with this move Secretary Barrows will soon take steps to have suitable sand and gravel specifications included in building ordinances of cities throughout the country. In this work he will call upon members of the association in their various cities to assist him.

Producers are again urged to bear in mind the necessity for the early movement of materials this year. The adequate supply of open-top cars which the industry enjoyed last year was due largely to the fact that movements of coal were light, but this year it is anticipated the movement of coal will be heavy, especially late in the summer and in the early fall. This, it is anticipated, will mean a shortage of cars for sand and gravel and, it is pointed out, that unless producers of this material move heavily during the early months of this year difficulties may be experienced in making deliveries later on.

The Interstate Commerce Commission has just taken steps to relieve the open-top car situation by ruling that industries owning coal cars devoted to their own use, after March 1, in the event of a car shortage, will not be permitted to designate the coal mines to which they shall be sent. This, however, should not be accepted by sand and gravel producers as meaning that they will be favored in the distribution of cars, but should follow the advice of the association headquarters and move materials as rapidly as they can be produced.

Railroads also are forbidden to assign cars to particular mines for their own fuel, but under the law, the commission might issue priority orders giving a particular company preference in the assignment of cars but special action in every case will be necessary. The decision is an affirmation of a decision made in 1923, which was hotly contested by affected interests. It is regarded as a certainty that the case will be taken to the Supreme Court of the United States by the owners of private cars. The order is based on a finding of unreasonableness and undue prejudice and also that, under the Interstate Commerce Act pro-rata distribution of privately owned coal cars may be required by the commission in times of car shortage. So long as there is an ample supply of coal cars, the order of the commission will have no effect.

To just what extent this ruling will affect distribution of cars to the sand and gravel industry is not made clear, but it is anticipated that if the commission shifts cars around to coal companies irrespective of ownership, the sand and gravel industry will be enabled to obtain a fair share of transportation.

Association headquarters here are predicting an active season for the sand and gravel industry. Official figures on sand, gravel and stone loadings up to this time are considered

encouraging and presage an active season as soon as the weather breaks.

Opposition to the report of Commissioner Joseph B. Eastman providing for revision of Southern class rates developed among shippers in argument before the Interstate Commerce Commission. Among the shippers who oppose suggestions made in the report were Edgar Moulton, representing the New Orleans Joint Traffic Bureau; J. S. Fletcher, representing Knoxville interests.

Mr. Moulton declared that the application of the report would disrupt rate groups that have existed for a long time, arguing that sufficient grounds for such a disturbance had not been presented. Representatives of the Tennessee cities also protested on the ground that the Eastman report provided for destruction of groups and group relationships.

Approval of the report, however, was given by J. O. Hendley, rate expert for the Tennessee Railroad Commission, who declared that Tennessee would be crushed by the railroad proposals as against the Eastman proposals, if the former were made effective.

"Industrial Type" Speed Transformer

THE Hill Clutch Machine and Foundry Company, Cleveland, Ohio have developed the "Industrial Type" Spur Gear Speed Transformer (patent applied for) realizing the urgent need for an efficient and durable speed changing device for such service as is encountered in connection with conveyor drives, in pulp and paper mills, mines, smelters, steel plants, refineries, cement mills, brick plants, and in fact for all general industrial work where speed transformer units are operated under continuous or heavy service conditions; in other words, something substantial to meet the every day rough usage of mill operation.

The "Industrial Type" speed transformer consists of a nest of plain spur gears revolving in oil, changing the revolutions per minute of the input shaft to some desired revolutions per minute of the output shaft. The power transmitted is the same in both shafts. The efficiency is higher than any other form of gearing. The gears all have 20 degree involute form cut teeth. The short length of these teeth combined with their powerful cross section insures great strength and reliability.

Of great importance is the central housing located in the main frame. With this construction it is possible to offer the trade a gear transformer having both high and low speed shafts supported in double bronze bearings, insuring strength, rigidity and smooth operation. They have also provided for ordinary thrust conditions.

Great accessibility is obtained as the cap and both ends can be quickly removed. The oiling arrangement is unique, being a continuous and thorough splash system lubrication obtained by a metal disc on the high speed shaft which automatically lubricates every gear and bearing in the case. The entire unit is enclosed, is dust proof and leak proof.

Both high and low speed shafts are in identical axial alignment. The action is positive and both shafts revolve in the same direction.

The "Industrial Type" speed transformer is made in seven sizes. Each size has a number which bears a fixed relation to the diameter of the low speed shaft. The number also indicates the horsepower the low speed is capable of safely transmitting at 100 R.P.M.

It is the "short cut" from electric motor to machine or from shaft to shaft where speeds are widely different. It eliminates cumbersome speed changing devices, saves power losses and being a closely coupled unit requires very little space for installation.

Loadings of Railroad Freight Increase

Loadings of revenue freight on the railroads during the week ended Jan. 3 totaled 765,727 cars, according to reports filed by the companies with the car service division of the American Railway Association. Notwithstanding that the week included the holiday of New Year's Day, this total showed an increase of 118,847 cars as compared with the previous week, which included Christmas Day, and it was also an increase of more than 59,000 cars as compared with New Year's week a year ago. All commodities showed increases in the freight movement in comparison with the week before, the greatest gains being in loadings of coal and of miscellaneous freight.

Call for Material Good

Prices for Building Materials Continues Firm, Crushed Stone Also. Preparations for Spring Operations Under Way

By Our Pittsburgh Correspondent

THE ADVENT of 1925 has brought real winter weather at Pittsburgh, Pa., ushering in the usual handicaps to the sand and gravel producers in this section. Production has necessarily been curtailed and the reserves which have been accumulating during recent weeks are now being utilized for current account. River steamers have been battling with ice on all three streams and shipping of any kind has been a difficult matter. The Allegheny River is frozen from the vicinity of Lock No. 2, at Asessen; the Monongahela is frozen from Lock No. 4, near West Monpinwall up to the head; while the Ohio River is likewise ice-bound at Portsmouth and other points.

The sand and gravel trade in this section is looking forward to a big year, and the next twelve months are expected to show one of the largest, if not the largest annual periods for production and sales. The enforced slack in daily outputs is being used to make ready for the months ahead. River fleets are being inspected and repaired, and arrangements are being made for the construction of new diggers and floats. The shipbuilding and repair plants in this district continue operations under peak conditions; many yards are more than busy and have bookings that will carry well beyond the spring season. Marine equipment and concerns, as well, are enjoying a heavy trade; there has been a substantial call for boilers, engines, pumping equipment and accessory apparatus for existing fleet replacements and for new vessels.

The call for material continues on a good basis for this season of the year and there is a healthy tone in the local market. Prices continue firm, with a customary slight advance over levels of a month ago, due primarily to seasonal retrenchment. Best river sand is being turned wholesale around $1.50 a ton at company yard hoists, with regular 10 per cent discount for building supply dealers, who, in turn, are quoting at $2.50 for delivered stock in smaller lots. Barge deliveries are ranging on a basis of $1.25 a ton.

First grade river gravel is selling at close to $1.00 and $1.10 a ton at yard hoists to contractors, with 10 per cent discount to dealers for resale. Loaded material, 1½ and ¾-in. sizes runs to $1.40 and $1.50 a ton, while barge stocks are proportionately less. There is a fair call for current deliveries, while incoming inquiries for future account are decidedly encouraging.

Crushed stone is selling at $2.85 a cubic yard in the wholesale market at Pittsburgh, 1½ and ¾-in. stocks, a figure which has been prevailing for some months past. Portland cement, wholesale, is quoted at $2.19 a barrel, less bags, in cargo shipments, or exactly the same level as at this same time a year ago. Supply dealers are asking around $3.00 a barrel, with regular 10-cent bag rebate, delivered on the job.

The Keystone Sand & Supply Co., Pittsburgh, is arranging plans for considerable increase in production and distribution during the year ahead. With a new digger in course of building at the yard of the Dravo Contracting Co., Neville Island, the company has placed an order for 20 or more barges to be used for hauling stocks to the local port and vicinity. The Dravo company, in turn, is arranging to sponsor an issue of $400,000, in trust certificates, to carry out the work. The Keystone company is maintaining good activities for this season of the year, and is making a considerable turn-over.

The Pittsburgh White Sand Co., Mapleton, Pa., has acquired the property of the Speer White Sand Co., at Berkeley Springs, W. Va., and plans for extensive operations at this point. The company is said to be arranging for immediate expansion in production facilities, and will give employment immediately to a large working force under full time operations. The plant will be in charge of W. C. Stevenson, as manager.

J. K. Davison & Brothers, Pittsburgh, one of the largest producers in this district, has laid up its electric-operated dredge, "Allegheny," for general repairs, and expects to have the digger ready for service at an early date. It has now been in operation for more than three years, in charge of Captain Charles E. Smith.

The Morgan Sand and Gravel Company, Inc., of Brooklyn, recently increased its capital stock from $50,000 to $100,000.

E. J. Armstrong Passes On

EDWIN JAMES ARMSTRONG, chief engineer of the Erie Steam Shovel Co., Erie, Pa., died January 21, 1925, at Savannah, Ga., where he recently went to regain his health, failing for several years past. Mr. Armstrong was born May 12, 1861, at Hornby, Steuben Co, N. Y., the oldest of four children. His education consisted entirely of home study, which was continuous throughout his life.

The family occupation was lumbering, in which young Edwin early took an active part. He also picked up the old-fashioned gunsmith trade, and later became apprentice to A. Weston & Company of Painted Post, N. Y., serving for four years. At the end of the second year, however, the firm made him shop foreman, and though green and untrained to be in authority over others, he made good and later was superintendent for about nine years. In 1887 he married Miss Alice Wood of Painted Post.

Mr. Armstrong enjoyed a life-long friendship with Prof. John E. Sweet of Syracuse, (founder of Sibley College of Engineering of Cornell University) and for awhile in 1888 worked for the Straight Line Engine Co. of which Mr. Sweet was president. At about this time A. Robb & Sons, a small concern engaged in building saw-mill machinery in Amherst, Nova Scotia, decided to build high-speed steam engines for operating small electric light stations, and engaged Mr. Armstrong. His report was unfavorable, because of the unfitness of the workmen to handle such work, and the prohibitive cost of bringing in Americans. The firm being insistent, Mr. Armstrong suggested the establishing of a small training school in which to train a force of workmen.

A class of twenty boys therefore began an intensive manual course, and later the youngest of the Robb brothers, then at the Massachusetts Institute of Technology, came home to begin training to become the future designer and shop superintendent. This was the beginning of a highly successful business. Mr. Armstrong was actively engaged with it for but one year, but considered this one of his most interesting experiences.

In the spring of 1900 Mr. Armstrong entered the employ of the Ball Engine Company (now the Erie Steam Shovel Company) as chief engineer. Later he became a director, and took considerable part in the development of the steam shovel business.

Mr. Armstrong was a life member of Montour Masonic Lodge, Painted Post, N. Y., and also of the American Society of Mechanical Engineers, the American Association for the Advancement of Science, and the Paleontological Society of America, and the Erie University Club.

The "Whippet" Speeder Crane

A new bulletin gotten out by The Speeder Machinery Corporation of Fairfield, Iowa, describes the "Whippet" Line of Light, Speedy, Strong Cranes,—for the big fellow's little problems and the little fellow's big problems.

The Speeder Crane has been developed to meet the need for a light, economical crane and excavator to fill the gaps which always exist between heavy, expensive equipment and hand labor. It has been designed for Dragline, Clam Shell, Crane and Shovel use, and to make the change from one type to another no additional drums or other attachments are necessary other than the boom change.

The machine is described as extremely versatile, with decided flexibility and shiftiness, and capable of driving over all kinds of country roads. Two speeds on the drums assures abundance of power. The Speeder can be furnished either as a caterpillar machine or as a truck crane.

Numerous illustrations show The Speeder at work on operations of varied kinds. It can be used as Dragline, Pile Driver, in Clam Shell or Orange Bucket work, or as Shovel Crane or Backfiller.

New Gits Bros. Catalog

Catalog No. 20 has just been issued by The Gits Bros. Mfg. Co., 1911 South Kilbourn Avenue, Chicago. It covers the full line of oil cups and other lubricating devices manufactured by this company. The value of the book to maintenance engineers and others charged with the upkeep of the transmission layout is increased by considerable engineering data included in it.

Twin Disc Opens New Field

MANY manufacturers of industrial machinery now using Twin Disc clutches as an integral part of the machines they sell, will be interested to know of a new development that enables them to apply the well-known Twin Disc standards of efficiency and economy to the transmission of power in their own shops and factories.

By making certain changes in hub design necessitated by the conditions of shop power transmission, the manufacturers of Twin Disc clutches have succeeded in producing a complete line of transmission shaft units. These new units meet all the requirements of power transmission installations. They can be used as shaft couplings; as duplex units for use with reversing drives; to drive pulleys direct, or to attach to spiders carrying gears, sprockets or pulleys. They will be called Model F, Twin Disc clutches.

In the manufacture of Model F clutches provision has been made to overcome discrepancies in shafting sizes. In order to reduce production costs to the required minimum, it was necessary to produce these clutches in quantity. They will therefore be carried in stock, both by jobbers and at the factory, with hubs bored to minimum sizes. The purchaser may either buy the clutch as made, and himself rebore the hubs to the required sizes, or he can furnish the factory or jobber with correct measurements and have the clutches delivered ready for immediate installation.

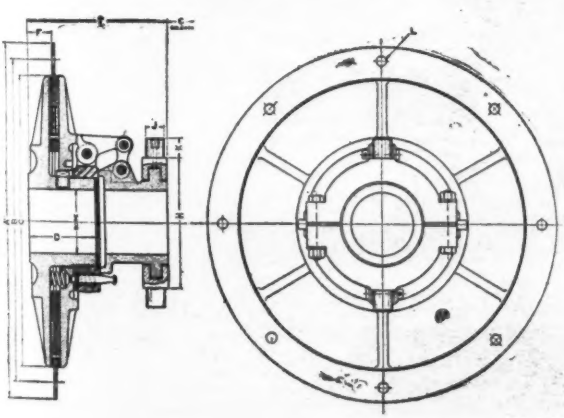
The high standards of efficiency in construction and operation which are characteristic of all Twin Disc clutches are maintained in the new Model F line. They are built of the best materials suitable for each part, accurately machined to automotive standards of tolerance, and are all equipped with the patented Twin Disc adjustment which provides for simultaneous take up on all levers without the use of tools. These clutches require so little attention and are so very easy to adjust properly that the machine operator can safely be entrusted with the care of the clutch used to drive his machine.

New Foote Catalog

Foote Bros. Gear & Machine Co. now has in course of preparation a new general catalog which will cover completely all their lines of industrial gears, machines, racks, sprockets and spur and worm gear speed reducers.

In addition it will contain a great deal of general engineering information, tables formulae and data which will make it very valuable as a reference book.

It is the aim of the company to make this book more interesting and instructive than the usual catalogue of this kind. Much time and effort is being put into compilation of the information, photographs and data and it will probably be several months before it will be ready for distribution.



The New Twin Disc Clutch Model F.

A New Belt Fastener

THE Bourne Fuller Company, Upson Works, Unionville, Conn., announce a new belt fastener, The Standard Self Aligning which embodies all the old principles which have made the split rivet type fastening successful, and new ideas which greatly increase its efficiency.

The middle nibs or lips align the fastener across the belt, their "V" shape allowing the belt ends to come together, making the belt practically endless, and the load is evenly and widely distributed.

The end nibs or teeth which are driven into the belt are made for two purposes; one to hold the plate in place while the rivets are driven and clinched, and the other to relieve the rivets of the strain; hence only one half of the usual rivets are required, making the belt quicker to fasten or take up.

The projections in the rivet hole guide the rivet lengthwise of the belt, thereby displacing less material, preserving the strength of the belt and preventing the belt from breaking at the back of the fastening. The embossing around the rivet hole makes it easy to remove rivets.

The plates are bent to the periphery of the pulley, and the fasteners are applied to the belt in small units allowing the belt to conform to crown pulleys and cross belts.

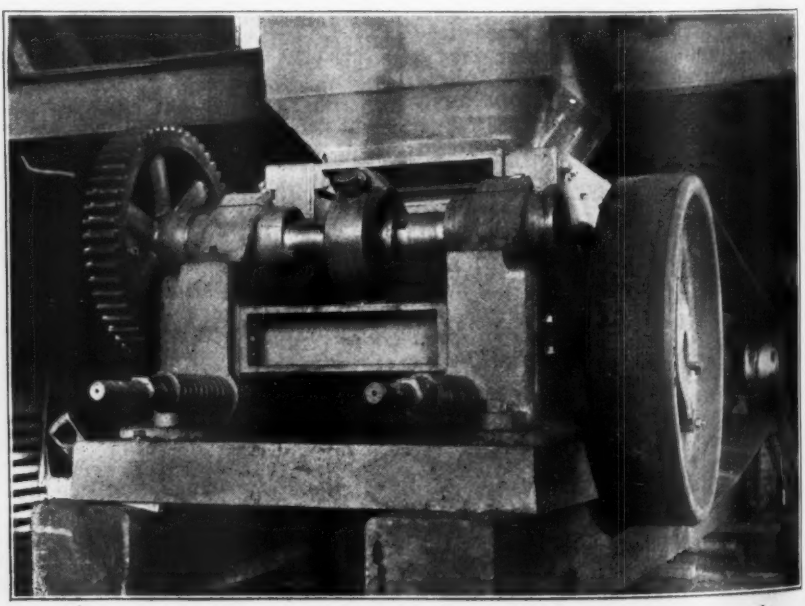
The Standard Self Aligning Fastener will fasten leather, rubber or woven belts and can be used over again. The only tools necessary are, a hammer to fasten and a rivet extractor to remove rivets.

A New Crusher

A new and unique crusher combining the gyratory and jaw principles is being manufactured by the Vogt Brothers Manufacturing Company of Louisville, Kentucky. This new crusher is but three feet high with a 24-inch opening. Material can be reduced from 18 inches to chips in one feeding.

The crusher uses the jaw stroke at the top and the gyratory movement at the bottom, both being combined to give a carefully synchronized motion. The upper shaft has a normal speed of 125 r.p.m. while the lower has a speed of 250 r.p.m.

The machine can quickly be adjusted to produce any size from six inches to dust in about five minutes. All parts subject to wear are easily accessible so renewal parts can be quickly fitted.



The new Vogt Brothers crusher

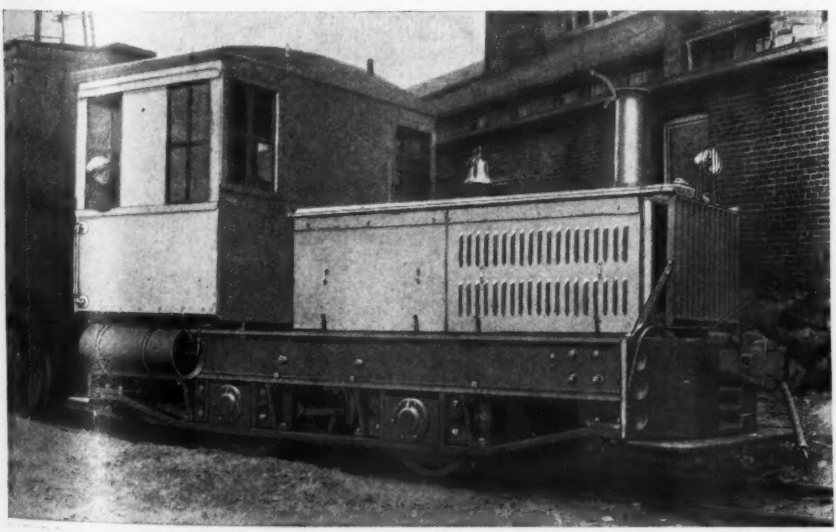
New Plymouth Gasoline Locomotive

THE Fate-Root-Heath Company (Plymouth Locomotive Works) Plymouth, Ohio, announce, as an addition to their present extensive line of Models and sizes, their new Model HL 18-ton for which they report an urgent demand developing due to the growing popularity of gasoline powered equipment of various kinds. This Model is offered by them for switching of railroad cars and for the handling of large and heavy industrial and construction cars. It is furnished in all track gauges from 23⅝ to 56½ inches.

It is built on very heavy lines and very substantially throughout, the foundation being an exceedingly heavy frame with steel girder-beam and bar sides and cast steel bumpers of liberal dimensions to withstand the severe strains and stresses thrown upon a locomotive in the service for which it is intended. The wheels, all four of which are drivers, are 33 inches in diameter with flange and tread suited to type of track used, either standard railroad or industrial. The axles are alloy steel, heat treated and fitted with Hyatt heavy duty roller bearings with hardened sleeves to take the wear of the bearings, and the bearings enclosed in dust proof journal boxings carrying bronze thrust plates to take care of the thrust of the axles. Various size shims, that space the journal boxes, afford an excellent and easy means of chain adjustment. Two well proportioned coil springs are provided with each journal boxing, affecting positive yet easy spring action and easy riding of the locomotive.

The power plant consists of a Climax R-6, 6-cylinder, vertical, L-head engine, with 5½ inch bore and 7 inch stroke, of heavy duty type with full force feed oiling system and built-in governor. This is provided with high tension dual ignition system, using both magneto and battery to insure positive service. Stromberg M-5 carburetor, with air cleaner, is used, that is especially designed for this size engine and the sudden demand for its full power. A 12-volt back geared starting motor and large storage battery afford a positive starting unit ready under all conditions. Modine sectional spirex core radiator with 30 inch diameter fan affords ample cooling for this large engine under the heaviest kind of work.

The clutch is a combination of Twin Disc and Plymouth design, the faces being very wide to insure positive contact when engaged and at the same time easy action when being engaged. A very valuable feature is



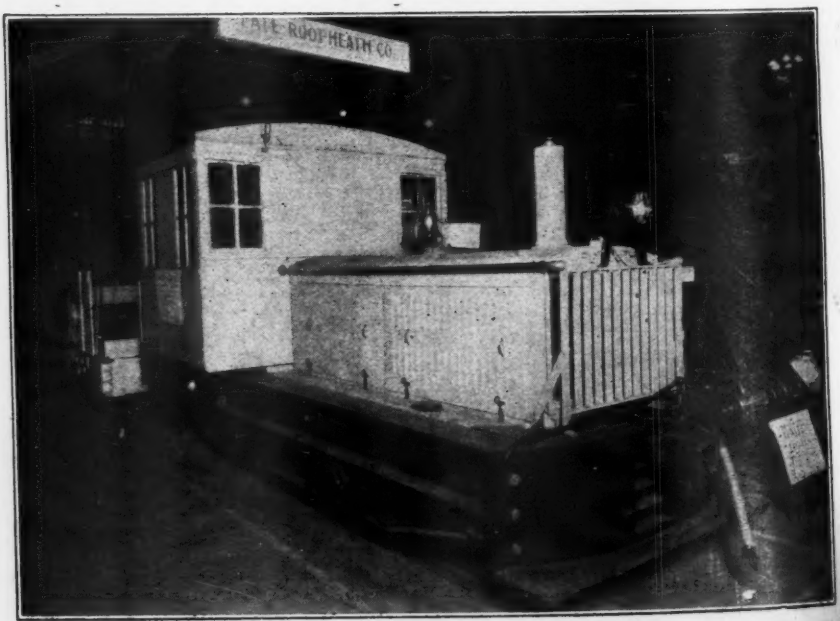
The New 18-Ton Plymouth Locomotive.

provision through a drilled clutch shaft for lubricating with Alemite gun the pilot bearing in the fly wheel.

The transmission is the Plymouth standard sliding gear type with 4 speeds both forward and reverse, providing speeds of 2⅔, 6, 12 and 24 miles per hour. This transmission embodies the Plymouth feature of the final driving shaft and gear being used in the gear case and in addition a double reduction between the clutch and regular driving gears. The gears are all high-grade alloy steel cut and hardened with faces from 2½ to 5 inches wide and from 6½ to 28½ inches in diameter but are shifted with great ease. All shafting and bevel reversing gears are carried on high-grade ball bearings mounted in, and lubricated automatically from the inside of, the gear case. This transmission is designed with the idea of eliminating the difficulties incident to the use of jaw clutches, and the gears are of such design as to insure exceedingly long life.

Hand brakes, of the hand wheel and screw type, operating brakes on all 4 wheels are provided regularly for industrial service, while straight system air brakes are furnished when required, as are also Westinghouse automatic air brakes for railroad service. The sanders are air operated insuring a positive flow of sand through the large sized flexible sand pipes. This type of sander is furnished, whether air brakes are supplied or not, in connection with an air whistle which is standard equipment. In addition to the whistle a bronze bell completes the signaling equipment. A 50-gallon fuel tank affords a supply ample for quite a wide operating range.

The cab is 11 feet high and 10 feet wide in the case of 56½-inch gauge, affording the best possible vision alongside of the train as well as over the top of gondola cars or large industrial or construction cars. Two seats are provided for the operator, one for traveling forward and the other for travelling backward, both located on the right hand side with the clutch lever operating from either position, enabling the driver to operate without inconvenience in either direction. Sliding windows are provided in the cab on both sides, front and rear. The cab, as well as the hood over the engine are of steel construction and can both be quite readily removed, should occasion desire. The rear of the cab is closed with swinging door, opening into the middle of the cab.



The New Plymouth At 1925 Road Show.